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FIFTY-SECOND
ANNUAL REPORT OF THE SECRETARY
OF THE
MASSACHUSETTS
STATE BOARD OF AGRICULTURE,

TOGETHER WITH THE

SEVENTEENTH ANNUAL REPORT OF THE HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE.

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STATE BOARD OF AGRICULTURE, 1905.

Members ex Officio.

His Excellency WILLIAM L. DOUGLAS.
His Honor CURTIS GUILD, Jr.
Hon. WM. M. OLIN, *Secretary of the Commonwealth.*
H. H. GOODELL,* M.A., LL.D., *President Massachusetts Agricultural College.*
C. A. GOESSMANN, Ph.D., LL.D., *Chemist of the Board.*
AUSTIN PETERS, M.R.C.V.S., *Chief of the Cattle Bureau.*
ALFRED AKERMAN, M.F., *State Forester.*
J. LEWIS ELLSWORTH, *Secretary of the Board.*

Members appointed by the Governor and Council.

	Term expires
FRANCIS H. APPLETON of Peabody,	1906
WARREN C. JEWETT of Worcester,	1907
WILLIAM R. SESSIONS of Springfield,	1908

Members chosen by the Incorporated Societies.

Amesbury and Salisbury (Agr'l and Hort'l),	J. J. MASON of Amesbury,	1906
Barnstable County,	JOHN BURSLEY of West Barnstable,	1907
Blackstone Valley,	SAMUEL B. TAFT of Uxbridge,	1906
Bristol County,	WILLIAM A. LANE of Norton (P. O. Barrowsville),	1908
Deerfield Valley,	E. P. WILLIAMS of Ashfield,	1908
Eastern Hampden,	O. E. BRADWAY of Monson,	1906
Essex,	JOHN M. DANFORTH of Lynnfield (P. O. Lynnfield Centre),	1908
Franklin County,	JOHN S. ANDERSON of Shelburne,	1907
Hampshire,	HENRY E. PAIGE of Amherst,	1907
Hampshire, Franklin and Hampden,	J. F. BURT of Easthampton,	1906
Highland,	HENRY S. PEASE of Middlefield,	1908
Hillside,	RALPH M. PORTER of Cummington,	1908
Hingham (Agr'l and Hort'l),	EDMUND HERSEY of Hingham,	1906
Housatonic,	CHARLES H. SHAYLOR of Lee,	1906
Marshfield (Agr'l and Hort'l),	HENRY A. TURNER of Norwell,	1906
Martha's Vineyard,	JOHNSON WHITING of West Tisbury,	1907
Massachusetts Horticultural,	WM. H. SPOONER of Jamaica Plain,	1906
Massachusetts Society for Promoting Agriculture,	N. I. BOWDITCH of Framingham,	1906
Middlesex North,	H. S. PERHAM of Chelmsford,	1907
Middlesex South,	ISAAC DAMON of Wayland (P. O. Cochituate),	1908
Nantucket,	H. G. WORTH of Nantucket,	1906
Oxford,	W. M. WELLINGTON of Oxford,	1907
Plymouth County,	AUGUSTUS PRATT of North Middleborough,	1908
Spencer (Far's and Mech's Assoc'n),	H. H. LEACH of North Brookfield,	1907
Union (Agr'l and Hort'l),	ALBERT H. NYE of Blandford (P. O. Russell),	1907
Weymouth (Agr'l and Ind'l),	QUINCY L. REED of South Weymouth,	1906
Worcester,	WALTER D. ROSS of Worcester,	1908
Worcester East,	W. A. KILBOURN of South Lancaster,	1906
Worcester Northwest (Agr'l and Mech'l),	ALBERT ELLSWORTH of Athol,	1907
Worcester South,	C. D. RICHARDSON of West Brookfield,	1907
Worcester County West,	J. HARDING ALLEN of Barre,	1908

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* Died April 23, 1905.

THE FIFTY-SECOND ANNUAL REPORT

OF THE

SECRETARY

OF THE

STATE BOARD OF AGRICULTURE.

To the Senate and House of Representatives of the Commonwealth of Massachusetts.

Having completed my first full year as secretary of the State Board of Agriculture, it becomes my duty to present for your consideration the fifty-second annual report of the Board. It has been a year of varied activities and of hard work for the advancement of agriculture, and, while we may hesitate to claim too much credit for the developments of the year in our lines of work, it is but right to say that the Board has been a large factor in and of them. The various divisions of the work of the Board are fully treated under the proper headings, and need not be referred to here.

The year just closing has been in the main a profitable one for our farmers, as good crops have generally been secured, and prices, except for apples at time of harvest and to a less degree for potatoes, have ranged well up to those usually received. Market gardeners have had a profitable season, though not so good as last year. Dairymen received good prices for their products, and went into the winter with well-filled barns and stock in good condition. Poultry raisers received prices rather above the average, and good care was rewarded with at worst fair results. Of our specialists, horticulturists have perhaps the most cause to complain, owing to the damage to peach trees from the severe winter and the low price of apples at time of harvest. Those apple growers who were so situated as to be able to hold their crops in storage reaped a substantial reward for their investment and trouble.

Agriculture in Massachusetts, and we may say in New England as a whole, though perhaps more especially in our own State, has come to be a matter of specialization and close attention to detail. We no longer compete with the fertile and easily tillable farms of the great west in the production of the cereals and staple crops, but in our own lines great rewards still await the careful student of conditions and methods. The market at our doors is one of the best — perhaps the best — in the world; but it is a critical market, an educated market, one trained by years of the best to accept nothing but the best, and to go beyond our local producers when they do not furnish it. There is still an outlet for an immense amount of inferior produce, but at prices usually below the level of profit. It is by seizing the opportunities presented, by catering to the demands of our market and by creating new ones, that the long list of marked successes in agriculture in Massachusetts have been produced. Fresh, sweet, wholesome milk and cream, fresh vegetables, strawberries with the dew still on them, table fruits of all kinds suited to the climate, provided they are of the first quality, find a ready sale, and at prices highly remunerative. In greenhouse products many a farmer has found the opportunity to make skill and energy yield him a handsome profit. With the great variety of soil and exposure which our diversified surface affords, there is opportunity for an exceedingly wide range in the choice of lines of special work. To the farmer who studies his market and directs his natural resources with intelligence and judgment, farming in Massachusetts will prove more profitable than in any other section of the country. He must, however, be alive to the situation, and ready to discard old methods and ideas for those of more modern date.

It is in keeping abreast of these developments, in giving aid to those who are seeking for new lines of work or to improve old methods, that the greatest usefulness of this Board must lie. The opportunities for useful service in these lines, through our agricultural societies, through the lectures at the winter meeting of the Board and at the farmers' institutes, and through our annual report, our crop reports and special bulletins, are manifold, and will be greater in the future than in the past. Last and least, perhaps, in the number of people reached, but nevertheless of constantly increasing importance, is the work which we are able to do by consultation and correspondence. Much of the information which we publish and disseminate is of interest to those not engaged in agriculture in a commercial way, but on a small scale for their own pleasure, their profit being found rather in the satisfaction of having choice products of their own raising for their tables than in the production of a surplus for the market. I am glad to be able to say that our work is not unappreciated, and that the commendations freely given from many sources are not the least of the factors that will spur us to renewed efforts in the future.

Changes in the Board.

Changes in membership resulting from elections by the several societies will be given in the report of the committee on credentials in the proceedings of the annual meeting. The number of ex-officio members has been increased by the addition of the State Forester, Mr. Alfred Akerman, under the provisions of chapter 409 of the Acts of 1904. Members retiring because of expiration of term of service are: Arthur A. Smith of the Deerfield Valley Agricultural Society; C. K. Brewster of the Highland Agricultural Society; and J. W. Gurney of the Hillside Agricultural Society.

Meetings of the Board.

For the summer meeting of the Board, held at the Massachusetts Agricultural College, Amherst, June 16, the plan of having a field day and demonstration work was tried, with marked success. The mixing and preparation of the Bordeaux mixture, the fumigation of a tree with hydrocyanic acid gas, the demonstration of the operation of the Babcock test and of Farrington's pasteurizer, with the workings of several different makes of separators, were all given practical demonstration; and, in addition, Prof. Wm. P. Brooks explained the experiments carried on at the experiment station in grass raising. In the afternoon Dr. Geo. M. Twitchell of Maine gave an interesting address on the subject "Harness your forces." It is my present plan to make this demonstration work an annual feature of the summer meetings of the Board. A detailed account of this successful and valuable meeting will be found printed in this volume.

The public winter meeting for lectures and discussions was held at South Framingham, on invitation of the Middlesex South Agricultural Society, and was one of the most successful for a number of years, the lectures being uniformly of the first rank in thought and treatment, the discussions concise and intelligent, and the attendance fully up to the average in number and perhaps above in mental grasp and alertness. A pleasant feature of the meeting was the visit to the farm of Mr. N. I. Bowditch of the Board, on the afternoon of the last day of the meeting. The lectures and discussions will be found printed in this volume.

The annual business meeting of the Board was held at Boston, Jan. 10 and 11, 1905. The minutes of this meeting, together with the reports submitted by the various committees, will be found printed in this volume. Special business meetings were held at the summer and winter meetings.

AGRICULTURAL SOCIETIES.

The incorporated agricultural societies of Massachusetts had in the main a successful year, both from a financial standpoint and from that of their fulfilling their mission in assisting in the improvement of agriculture in the Commonwealth. There were a few exceptions to the general rule of financial success, caused by unfavorable weather, and perhaps one or two that might have been avoided by more careful business management. The tendency of officers and boards of management is undoubtedly in the direction of strictly agricultural fairs, two more societies having adopted the policy of excluding all fakirs and attractions from their exhibitions, with marked success from an educational standpoint, and, so far as I have been able to learn, without financial loss. The attendance suffered, to be sure, but the absence of bills of expense for attractions appears to have more than counterbalanced the decrease in revenue from this source. That those who attended did so from an interest in agriculture seems apparent, and there can be no question but that they had a better opportunity to inspect the exhibits and draw useful lessons from them than when their attention was distracted by numerous outside attractions. Six of the societies holding exhibitions have adopted this course, and of the remaining twenty-four in at least five instances the sum paid for attractions is so small as to have no appreciable effect on the question of a favorable balance at the end of the year. It is a noticeable and important fact that these societies are able to meet their obligations each year, even in bad weather, and to lay up a balance of more or less amount on the right side of the ledger when favored with good conditions. Their example is commended to the other nineteen for careful study and consideration, with the belief that if they will adopt a policy of the same sort they will find it to be equally advantageous.

The fairs held this year have been generally fortunate in weather conditions, though it is inevitable that some should suffer from rain and threatening weather every year. The attendance, so far as reported on by the inspectors, was fully up to that usual in the different sections, and in some cases was larger. The moral plane of the exhibitions has been high. It is to be expected that objectionable side shows will sometimes obtain footing on fair grounds under false pretences, but all such are reported to have been suppressed and ejected from the grounds. But one infraction of law was reported by an inspector, and that is at present under investigation by the committee on agricultural societies.

I would renew my recommendation of last year, that the societies pay careful attention to their business management, should exercise caution as to the engaging of attractions, and should establish a sinking fund from which unavoidable losses due to bad weather or damage to the property of the society may be paid. I would also renew my recommendation for a thorough overhauling of the premium lists of the societies. One society was caught this year through its making the old offer of a sum for the best specimen of any other breed or variety, and had to pay a large sum for exhibits of no prominence or value for other purposes than as curiosities. That society will undoubtedly provide against a repetition of the trouble, and others should take advantage of the lesson pointed out, and not wait for the bitter lessons of adversity.

I would further recommend that the societies employ expert judges, not members of the society or residents within its limits, to do the judging in the live stock and poultry classes. That this may not be an undue burden on the poorer societies, the attention of the Board and the Legislature is called to the suggestion that the societies be authorized to expend a portion of the State bounty in paying for the services and expenses of such judges.

FARMERS' INSTITUTES.

The farmers' institutes are supported from the appropriation for "the dissemination of useful information in agriculture," which was $2,700 for the year 1904. This appropriation was sufficient to meet all bills for the year, the work having been arranged with that end in view; but if the increased appropriation asked for had been given, much more could have been done. With an increase to $3,000 a greater number of meetings might be held in sections where they would be appreciated, and something done towards the holding of demonstration and field meetings. Without this increase nothing can be done in this line except by curtailing work in some other direction, therefore development in this field of work must rest on the action of the Legislature.

During the institute year just closed two circuits of institutes were held, with good results in saving of expense and convenience of speakers. We have arranged with four speakers from without the State — Prof. J. W. Sanborn of Pittsfield, N. H.; Prof. John Craig of Ithaca, N. Y.; Prof.

C. S. Phelps of Chapinville, Conn.; and Dr. J. L. Hills of Burlington, Vt. — to give us a week's time each during the months of January, February and March of this year, and we hope to arrange a good circuit of meetings for each of them. All these speakers are in the first rank as institute workers, and will have something to offer of more than average value to our farmers. They will not be engaged for single meetings at other times during the institute season.

The institutes of the year have been more than commonly successful, both in attendance and interest. No lecture has been delivered by any speaker receiving compensation from the treasury of the Commonwealth that has not been agricultural in its nature. One hundred and fourteen meetings have been held during the year, under the direction and control of this Board. All the societies represented on the Board held 3 or more institutes, except the Hingham Agricultural and Horticultural Society, which held but 2, and the Massachusetts Society for Promoting Agriculture, which is represented on the Board by special act, and holds no institutes, while 6 societies held 4 or more. Eleven other meetings have been held in various sections where there is no agricultural society represented on the Board, and where there is a demand for such meetings. The average attendance for the year has been the largest since records of attendance have been kept, being 109, as against 102 for last year, 104 for 1902, 107 for 1901, 91 for 1900 and 94 for 1899. At two of the meetings the attendance was 300 or over, at 21 from 200 to 299, at 29 from 100 to 199, at 38 from 50 to 99, and at 24 it was less than 50. During the year the work showed encouraging signs of progress in certain sections where it has heretofore been weak, and we hope to be able to make an equally satisfactory report for the other weak spots when the time shall come for a summing up of the work of 1905.

Nursery Inspection.

This work has been thoroughly organized under the competent direction of the present Nursery Inspector, and the third year of the work shows a further improvement in the condition of nurseries. Such infractions of the law regarding the sale of nursery stock as have been reported during the past year have arisen from mistake rather than through malice, and have been of a minor nature. That nursery stock from Massachusetts nurseries is now considered as free from danger of insect or fungous infestation is a grand testimonial to the value of the work, when we consider the extremely dangerous conditions that prevailed in many nurseries prior to the enactment of the law. It is possible that a few perfecting amendments may be presented to the current Legislature, but it is in the main working smoothly and satisfactorily. The report of the Nursery Inspector will be found printed in this volume.

DAIRY BUREAU.

The secretary of the Board is the executive officer of the Bureau, and, as the headquarters of the Bureau are in the office of the Board, he has kept in close touch with its work. He has nothing but commendation for the excellent way in which it has been carried on during the year by the general agent. More inspections have been made during the year than ever before, and fewer infractions of the laws relating to dairy products detected, indicating that the past work of the Bureau has been efficient, and that present conditions in the trade are favorable to the producer. Advanced work has been commenced along educational lines. For further details see the report of the Bureau, printed in this volume.

CATTLE BUREAU.

I renew my recommendations of a year ago in regard to the above-mentioned Bureau. The report of the Chief of the Cattle Bureau will be found printed in this volume.

STATE FORESTER.

Chapter 409 of the Acts of 1904 establishes the office of State Forester in this Commonwealth. Provision is made in this law that the State Forester shall be appointed annually by the Governor, that he shall be a trained forester who has had technical education as such, that he shall be ex officio a member of the State Board of Agriculture, and that his report shall be printed in the report of the said Board. In defining his duties, it provides that he shall issue such publications as he deems necessary; that he shall visit such land owners as may request him to do so, and advise with them as to the management of their forest property, but at their expense; that he shall deliver a series of lectures on forestry to the students of the Massachusetts Agricultural College; and that he may establish a nursery for the growth of forest trees on the grounds of the said college.

I regret that his work should be hampered by imposing the costs of inspection upon the owners of forest areas, and that some provision was not made for the purchase and improvement of the waste areas of the Commonwealth in forest growth; but it is possible that these defects in the present law may be remedied by future enactment. An opportunity for making this work more effective and of introducing it to the favorable attention of the farmers of the Commonwealth was lost when the position was established as a separate office.

The report of the State Forester will be found printed in this volume.

MASSACHUSETTS AGRICULTURAL COLLEGE.

As the State Board of Agriculture is by law a Board of Overseers of the Massachusetts Agricultural College, a few words in regard to that institution would seem to be in order. I understand that the college entered last fall upon a year which promises to be the most successful in its history. The entering class is the largest on record, as is also the total attendance at the college. New buildings are needed for the proper instruction of the large number of young men now being received each year, and it will not be long before further dormitory accommodations will be necessary, or the Commonwealth will be obliged to adopt the alternative course of turning away a large number of those seeking entrance. The Board of Trustees of the college will ask the present Legislature to make substantial appropriations for the purposes indicated, and I bespeak of the Legislature its favorable consideration of the request. The Board has this year, as always, endeavored to keep in close touch with the college, and to be of as much assistance as possible in bringing its work to the attention of the people of the Commonwealth and supporting it in every way. The summer meeting on June 16 brought many to visit it, and the results of the inspection and the lessons learned could not but be beneficial to the college as well as to those present.

THE GYPSY AND BROWN-TAIL MOTHS.

The degree of infestation by these insects, and the serious menace which they, more particularly the gypsy moth, afford to the agriculture of the Commonwealth, is fully treated in the report of the committee on gypsy moth, birds and insects, printed in this volume, and the recommendations of that committee leave little to be said in this report. I would, however, add my personal voice to the call for aid in combatting the gypsy moth that is going up from the people of the infested district, and from those beyond that district who thoroughly understand the conditions and the menace embodied in them.

CROP REPORTS.

The publication of monthly crop reports has been carried on as heretofore. The special articles included in these reports were: "The hay crop in Massachusetts," by Prof. Wm. P. Brooks; "The growing of mushrooms," by Dr. Geo. E. Stone; "The gypsy and brown-tail moths," by A. H. Kirkland, M.S.; "Harvesting and marketing apples," by Prof. F. A. Waugh; "Breeds for the farm, and farmers as poultry breeders," by John H. Robinson; and "Bee keeping: how to meet its dangers and difficulties," by Burton N. Gates. All but the last one were illustrated. Upwards of 1,000 copies of these bulletins have been called for during the year, largely because of these special articles; and many of them have been coupled with the request that the writer's name be placed on the permanent mailing list. So many additions were made in this way that the edition increased from 3,400 for May to 3,800 for October. The edition of the bulletin for July was 4,500, because of the special demand for information on the gypsy and brown-tail moths, particularly the gypsy. It was thought that this number would suffice for the demands of another year, but the edition is now nearly exhausted. The crop report has been entered as second-class matter at the Boston post-office under the authority of act of Congress of June 6, 1900, with the result that an appreciable saving has been made in the cost of mailing.

NATURE LEAFLETS.

The following illustrated nature leaflets were issued during the year: "Massachusetts weeds" and "Potato rots," by Dr. Geo. E. Stone; and "Hints for out-door bird study," in four parts, by Edward Howe Forbush. There has been an increased call for these leaflets by teachers in the public schools and by pupils in the normal schools.

EXTRACTS FROM THE TRESPASS LAWS.

Chapter 444 of the Acts of 1904 requires that the secretary of the State Board of Agriculture cause to be printed such extracts from the trespass laws as in his opinion will tend to prevent depredations on farm and forest lands, on durable material, and to furnish not less than five copies to any reputable person applying therefor, and to send one copy annually to each post-office in the Commonwealth. There being no appropriation made for the carrying out of the provisions of this act, a full compliance with its requirements has been impossible. One thousand copies of a cloth poster were printed, at an expense of $46.48, and paid for from the appropriation for incidental and contingent expenses in the office of the secretary, and the necessary postage was paid from the same appropriation. The posters were received on July 18, and since that date 769 copies have been distributed, — 210 to residents of cities and 559 to residents of towns. Lack of funds prevented the sending of a copy to post-offices. Letters calling for the extracts have complained bitterly of depredations on the property of the writers, and it is hoped that these posters will act as a deterrent in the future. An appropriation of $300 has been asked for printing and distributing these posters for the current year, as, with an increased demand which is likely to arise, it will be impossible to meet the expenses from our appropriation for incidentals.

ABANDONED FARMS.

The efforts of this office to make known the locations and to secure the reoccupancy of farms in this Commonwealth for sale at a low price in proportion to their productive capacity, begun under the provisions of chapter 280 of the Acts of 1891, were discontinued after the publishing of the ninth edition of the descriptive catalogue, in September, 1901. In these catalogues descriptions of 747 farms were published, the total number of catalogues issued being 20,500. The number of *all* farms in the State by the census of 1885 was 45,010. At the time of issuing the final catalogue 334 of the farms advertised had been reported to this office as sold, and 122 descriptions had been withdrawn from the catalogue at the request of the owners. There are no statistics to show what changes of ownership have since taken place in the farms catalogued, but, as the tendency has been more and more strongly from the city to the country, it is believed that few if any of these farms are now unoccupied during portions of the year, if the buildings are habitable, or the land suitable for farming purposes connected therewith can be utilized by neighboring farmers to a greater or less extent.

Farm property, like any other species of real estate, goes onto the market from time to time for various reasons, and its sale does not necessarily mean a loss to the community or to agriculture. Frequently a sale results in appreciable gain to both. It is believed that when Massachusetts farms are sold they bring fair prices, and that the upward tendency of prices has been marked during recent years, especially in suburban communities and in localities particularly adapted to the finer branches of agriculture, such as dairying, fruit growing, poultry keeping, market gardening, tobacco raising, floriculture, etc.

A record kept of requests to this office by letter for catalogues or information about farm property since Jan. 1, 1903, shows the following: total requests, 595; from Massachusetts, 204; New York, 132; Illinois, 31; Connecticut, 22; New Jersey, 23; Ohio, 21; Pennsylvania, 19; Rhode Island, 15; scattering, 128. Thirty-seven States and Territories were represented in these calls, and 20 requests came from foreign countries, including Canada and the Provinces, Brazil, Greece, Australia, France, England and South Africa.

LEGISLATION.

The legislation of 1904 having reference to the Board of Agriculture or to the agricultural societies was: "An Act making appropriations for salaries and expenses in the office of the State Board of Agriculture, and for sundry agricultural expenses" (chapter 65); "An Act relative to the temporary industrial camp for prisoners" (chapter 243); "An Act relative to printing and binding certain public documents" (chapter 388); "An Act making an appropriation for exterminating contagious diseases among horses, cattle and other animals" (chapter 56); for a deficiency in said appropriation for 1903 (chapter 135); "An Act to establish the office of State Forester" (chapter 409); "An Act to prohibit depredations on farm and forest lands" (chapter 444); also, "Resolve to provide for compensating owners of animals killed in exterminating the foot and mouth disease" (chapter 17); and "Resolve to provide additional compensation for certain owners of animals killed in exterminating the foot and mouth disease" (chapter 29).

PUBLICATIONS.

The following publications were issued by this office in 1904, most of which may be obtained on application: —

	Pages.	Number.	Date of Issue.
Agriculture of Massachusetts, 1903, .	745*	15,000	June 10.
Crop Report No. 1, ...	40	3,400	June 4.
Crop Report No. 2, ...	40	3,500	July 2.
Crop Report No. 3, ...	40	4,500	Aug. 5.
Crop Report No. 4, ...	40	3,400	Aug. 31.
Crop Report No. 5, ...	40	3,700	Oct. 4.
Crop Report No. 6, ...	40	3,800	Nov. 7.
Nature Leaflet No. 20, . . .	8	700	July 12.
Nature Leaflet No. 21, . . .	4	700	July 18.
Nature Leaflet No. 22, . . .	8	700	Aug. 5.
Nature Leaflet No. 23, . . .	8	700	Aug. 5.
Nature Leaflet No. 24, . . .	8	700	Aug. 11.
Nature Leaflet No. 25, . . .	8	700	Aug. 11.

* Including sixteenth annual report of the Hatch Experiment Station of the Massachusetts Agricultural College, 175 pages.

There were also issued in pamphlet form the following excerpts from the "Agriculture of Massachusetts," 1903: annual reports of the Dairy Bureau, Chief of the Cattle Bureau, and State Nursery Inspector; "Outlook for New England agriculture," by Dr. Geo. M. Twitchell; "A forest policy for Massachusetts," by Dr. B. E. Fernow; "Progressive and profitable poultry culture," by Dr. A. A. Brigham; "Bee keeping: its pleasures and profits," by Dr. Jas. B. Paige; "The management of poultry on small farms," by John H. Robinson; and the special report on "The destruction of birds by the elements in 1903–04," by Edward Howe Forbush.

LEGISLATIVE APPROPRIATIONS: BOARD OF AGRICULTURE.

OBJECTS FOR WHICH APPROPRIATED.	1904.		1905.
	Appropriated.	Used.	Appropriated.
Bounties to societies,	$18,000 00	$17,518 10	$17,400 00
Salaries of secretary and clerks,	6,200 00	6,200 00	6,200 00
Travelling and necessary expenses of Board,	1,500 00	1,256 64	1,500 00
Lectures before the Board, etc.,	600 00	598 94	600 00
Dissemination of useful information in agriculture,	2,700 00	2,699 79	3,000 00
Travelling and necessary expenses of the secretary,	500 00	243 06	500 00
Printing 15,000 copies of "Agriculture of Massachusetts,"	6,000 00	5,667 80	6,000 00
Work of the Dairy Bureau, including salaries,	8,200 00	8,200 00	8,400 00
State nursery inspection,	1,000 00	818 12	1,000 00
Incidental and contingent expenses,	800 00	800 00	800 00
Printing and furnishing extracts from the trespass laws,	–	–	300 00
Totals,	$45,500 00	$44,002 45	$45,700 00

The Legislature of 1904 also appropriated $67,000 for exterminating contagious diseases among horses, cattle and other animals.

PRESS BULLETINS.

The issuing of press bulletins containing abstracts of the publications of the Board has been continued during the year. We wish to thank the press of the State for their courteous treatment of these bulletins, and for the wide publicity which they have given these abstracts. In this way we are enabled to reach many citizens of the Commonwealth, and bring to their attention information which we have prepared for their use, and of which they might not otherwise become aware. The large number of calls for our crop reports, referred to under that heading, shows that these abstracts receive a wide circulation and serve a useful purpose.

Respectfully submitted,

J. LEWIS ELLSWORTH,
Secretary.

BOSTON, Jan. 10, 1905.

SUMMARY OF CROP CONDITIONS, 1904.

The wet weather of May delayed farm work, and at the close of the month it was somewhat in arrears. Pastures and mowings wintered well, as a rule, secured a good start, and at the close of the month the prospect for grass was never better. Fall seeding generally wintered well and got a good start. The apple bloom was unusually heavy. Peach trees were badly winter-killed, and bloomed only in a few localities; cherries and plums made a full bloom, but there were some complaints of a light pear bloom. Few insects appeared, and they did but little damage. Spraying is generally practised by fruit specialists, and growing in favor with farmers. Farm help was fairly plenty; average wages, $20 per month with board, and $1.50 per day, or higher, without board. There was a slight increase in the acreage of potatoes.

Insects did less damage than usual in June. Indian corn was reported as small and backward, but of good color and otherwise thrifty. Haying was just beginning at time of making returns, with the crop not more than an average one, the damage from winter-killing being more serious than was expected. The acreage of early potatoes was considerably increased, with crop somewhat backward, but generally promising well. Early market-garden crops generally made good yields, and brought prices fully up to the average. The flow of milk was well maintained, with prices for dairy products showing a tendency to seek a lower level. Dairy cows were somewhat more plentiful than usual, with prices easier. Pastures were generally in good condition. Strawberries were a fair crop. Plums and cherries promised good yields. Apples set well and promised well.

In July insects did very little damage. Indian corn was still backward, but coming forward rapidly, and very promising. Much of the crop is used for ensilage. Haying was practically completed, the crop exceeding expectation, and being above average in quantity and of excellent quality. The amount of forage crops planted was slightly less than usual, but all promised well. Market-garden crops showed unusually good yields, with prices lower than usual, but not too low for profit. Few early potatoes had been dug, but the crop promised well. Returns did not indicate that the apple crop would be up to the average of a bearing year. Pears promised but a light crop; plums a heavy crop; peaches much below the normal; grapes promised well; cranberries much below average, owing to late frosts and hail. Pastures were reported as short and dry in some sections, but the rains of the closing days of the month corrected this condition. Rye, oats and barley were reported to be unusually good crops.

Indian corn continued somewhat backward during August, but was earing well, and promised a good crop. Rowen promised more than an average crop, and would have been even better, save that the first crop was cut too late on many fields. Potatoes were somewhat backward, but the vines were very heavy and a good crop promised, though blight was general in eastern sections, with some complaints of rot. The acreage of tobacco was little changed, and one of the finest crops ever secured was in prospect. Pastures have seldom been in better condition. Oats gave a very good crop, with barley unusually good as a forage crop and little raised for grain.

Uncut corn was severely damaged by frosts on September 22 and 23. More than an average crop of rowen was secured, and fall feed was in excellent condition in most sections. Less fall seeding than usual was done, but where put in early, a good catch was reported. Onions were considerably below a normal crop, though perhaps better than previously expected. Root crops generally promised well, though there were some complaints of injury from frost. Celery and other late market-garden crops promised well. In the western counties an extraordinarily heavy crop of apples was reported, but in central and eastern sections it was somewhat light, as a rule. Pears were a fair crop; peaches very few; grapes good, but injured by frost; cranberries suffered still further from the frosts, and was one of the lightest crops of recent years.

Reports from correspondents the last of October showed that Indian corn that was well ripened and harvested prior to the heavy frosts of September 22 and 23 gave a fine crop both of grain and stover. As a whole, the crop was below the normal. Ensilage corn was more generally secured in good order than was that raised for grain. Root crops were generally a good average, and where raised for market brought at least average prices. Potatoes rotted badly in some sections, but where rot did not occur gave a very heavy yield and proved profitable, though bringing less than average prices. Celery was a good crop. Fall feed held good, and farm stock went into the barns in unusually fine condition. Less fall seeding than usual was done, but both early and late appeared to be doing well. Prices for crops raised for market appeared to have a lower trend than for the past few years, due in a large measure, doubtless, to uncommonly heavy yields in many of the leading crops. Of 131 correspondents answering the question, "How have prices for crops raised for market compared with former years?" 20 spoke of prices as higher than usual, 7 as good, 59 as average and 43 as lower than usual. Prices for market-garden crops, potatoes and apples generally ruled lower than usual, while dairy and poultry products ruled as high or higher than usual.

Sixty-six correspondents, a bare majority, considered hay to have been among the most profitable crops; 44, potatoes; 16, corn; 11, tobacco; 8, sweet corn; 7, onions; 7, cabbage, etc. Forty correspondents, less than one-third, reported apples as among the least profitable crops; 31, potatoes; 22, corn; 8, cabbage; 6, onions; 6, squash; 4, tomatoes, etc.

Concerning the profits of the season, it may be said that market gardeners generally had a profitable season, though not as good as last year. Dairymen generally did well, and went into the winter with well-filled barns and stock in good condition. Poultry raisers received good prices for their products. Horticulturists had perhaps the most cause to complain, owing to the damage to peach trees from the severe winter, the low price of apples and the high price of barrels. Of the 132 correspondents answering the question, "Considered as a whole, has the season been a profitable one for your farmers?" 64 considered the season to have been a profitable one, 32 fairly profitable, 19 an average season for profit, 8 hardly an average one, and 15 that it had not been a profitable season.

MASSACHUSETTS WEATHER, 1904.

[COMPILED FROM DATA FURNISHED BY THE NEW ENGLAND WEATHER SERVICE.]

The weather of January was unusually severe, with cold waves of marked intensity, heavy and frequent storms, gales of great force, and snowfall of unusual depth. The monthly mean temperature was decidedly below the normal, being 8° below in interior portions of the State. The total snowfall for the month ranged from 4 inches on the coast to about 50 inches in some interior sections. As a whole, January may be considered one of the most severe months of the last century.

In February the monthly mean temperatures were again below the normal at all stations, the snowfall in excess of the average, though below the preceding month in amount; and the month was also characterized by severe and persistent storms along the coast, during which the wind blew with great violence. The month was a fitting climax to a winter that, so far as temperatures are concerned, is unprecedented in the official records.

In March the temperature at most points was below the average for the month, but with deficiencies less marked than in the preceding months. The same was true of the precipitation, mostly in the form of snow. The storms of the month were less severe and fewer in number than usual. The month closed with moderate weather, during which the snow disappeared except in protected places, giving conditions favorable to the beginning of farm operations.

April was very unpleasant, the weather being unusually cold and wet. With slight exceptions, the month was the coldest of its name on record. The precipitation was remarkably heavy, though well distributed through the period and over the territory. The monthly amounts were among the largest recorded for April. At the close of the month the season was generally estimated to be from ten to fifteen days behind the average.

The opening week of May was clear and sunshiny, with almost an entire absence of rainfall, and temperatures generally above the seasonal average, the days being quite warm and the nights cooler than usual. Rain on the 9th and 10th was followed by several days of unsettled but generally fair weather, ending with copious rainfall on the 19th. The temperature varied but little from the normal. The weather of the remainder of the month was characteristic of the season, — clear to partly cloudy skies, with well-distributed showers. The temperature of this period was continuously above the average. May as a whole was a very pleasant month, the weather being well suited to farm operations.

The weather of June was marked by an abundance of sunny days and a deficiency of rainfall. In a few sections there were violent local storms, but over the greater part of the State there was need of rain at the close of the month. General light rains on the 29th and 30th practically broke the drought. A conspicuous feature was the rather low temperature during the days, and uniformly and exceptionally cool nights. The daily mean temperatures were below the seasonal average continuously, the 5th excepted, until the 17th, but during the closing decade were near the normal. The monthly rainfall was little more than half the usual amount, but was well distributed through the period, so that the effect of the deficiency was less marked than would otherwise have been the case. Excepting the low temperatures, the weather of June was very pleasant.

July was notable for conditions near the seasonal in precipitation, temperature and sunshine. The precipitation, though below normal, was so well distributed that the deficiency was hardly noticeable. Thunderstorms were less frequent than usual, but in some sections unusually violent. The temperature was remarkable for equable distribution and uniform high range of the maxima and minima, with an absence of extremes in both. Some quite warm weather was experienced in interior sections, and on the coast there were several days of muggy, oppressive weather, though the maximum temperature was under 90°. Viewed as a whole, July was a very pleasant month.

August opened with several days of warm, showery weather, with muggy, oppressive atmospheric conditions. A week of cool weather, with scattered showers, followed. During the remainder of the month the weather was marked by periods of a few warm days, alternating with like periods of cool weather, with the mercury considerably below the average. The outcome was a monthly mean considerably below the normal. The precipitation was below the average from 20 to 30 per cent, but was quite equably distributed, so that there was little complaint of drought. Local storms were less frequent and violent than usual during August. The weather was very pleasant, with a notable deficiency of hot, humid days frequently characteristic of August.

September will go on record as a month of unusually few rainy days, with abundant sunshine, but with a heavy total rainfall. During the first decade there was very little rain, but on the 14th and 15th a downpour that has been but seldom equalled, with almost an entire absence of rain during the remainder of the month. The temperature records also show pronounced extremes. The maxima ranged in the 80s on a number of days, with muggy, oppressive temperature, and on the 22d and 23d dropped suddenly to points ranging from slightly above freezing in some sections to several degrees below in others. The monthly mean temperature did not depart greatly from the normal. Notwithstanding these unusual conditions, September, considered as a whole, was a pleasant month.

The first week of October was generally pleasant, with abundant sunshine. A week of overcast weather followed, during which more or less rain fell in about all sections. Fair weather, mostly with clear skies, again obtained, and continued through the 18th, followed by a widespread storm of much intensity on the 20th and 21st. During this storm the winds along the coast attained hurricane force, and caused considerable loss of life and of shipping, and much damage to shore and other property. The weather was fair and very pleasant through most of the remaining days of the month. Taking the month as a whole, the temperature was practically normal. While rain fell on about the average number of days, the monthly amounts were much below the average, and in many sections were little if any above half of the normal October rainfall. Generally speaking, the weather of October was favorable to farming operations.

November, as a whole, was a dry, cold month. The low temperature was determined by the uniform and continued low temperature rather than the minimum of the month. The month opened cold, and the daily temperature, almost without a break, was below the average till its close. There was also a marked deficiency in the precipitation, the monthly amounts in most instances being little in excess of one-half the monthly normals for November. The chief storm, and during which the major portion of the precipitation occurred, was on the 13th and 14th, snow falling in the interior and western sections, and rain along the coast. Precipitation occurred on an average of six days only, and the abundant fair weather and sunshine were very favorable to all out-door pursuits, and particularly to farming interests.

December was characterized by a continuation of the weather conditions that obtained through November, *i.e.*, abnormally low temperatures, with the precipitation considerably below the seasonal average. While temperature during the "cold spells" did not fall so low as in December of several other years, it was almost continuously low, the means for each day, with slight exceptions, being several degrees below the normals. Excepting in some of the eastern sections, the monthly snowfall was below the average. However, on account of the low temperature, the melting was slow, and, notwithstanding the small fall of snow, there was the usual amount of sleighing. The cold weather was very favorable to the ice harvest, and the harvesting began early and progressed under favorable circumstances.

METEOROLOGICAL OBSERVATORY OF THE HATCH EXPERIMENT STATION (MASSACHUSETTS AGRICULTURAL COLLEGE), AMHERST.

[Latitude, 42° 23' 48.5" N.; longitude, 72° 31' 10" W. Height of barometer above ground, 51 feet; above sea level, 273.5 feet. Height of wind instruments, 72 feet.]

ANNUAL SUMMARY FOR 1904.

Pressure (in Inches).

Maximum reduced to freezing, 30.63, March 5, 10 A.M.

Minimum reduced to freezing, 28.42, November 13, 10 P.M.

Maximum reduced to freezing and sea level, 30.96, March 5, 10 A.M.

Minimum reduced to freezing and sea level, 28.73, November 13, 10 P.M.

Mean reduced to freezing and sea level, 30.034.

Annual range, 2.23.

*Air Temperature (in Degrees F.).**

Highest, 94.5, July 19, 3 P.M.

Lowest, —26.0, January 5, 7.30 A.M.

Mean, 43.9.

Mean of means of max. and min., 44.0.

Mean sensible (wet bulb), 39.5.

Annual range, 120.5.

Highest mean daily, 79.5, June 26.

Lowest mean daily, —12.7, January 5.

Mean maximum, 54.9.

Mean minimum, 33.1.

Mean daily range, 21.8.

Greatest daily range, 49.0, October 17.

Least daily range, 3.5, March 22.

Humidity.

Mean dew point, 35.5.

Mean force of vapor, .354.

Mean relative humidity, 77.0.

Wind.—Prevailing Direction, West.

Summary (Per Cent).

South, 20.

North-west, 12.

North, north-west, 12.

North, 10.

West, 10.

Other directions, 36.

Total movement, 46,994 miles.

Greatest daily movement, 450 miles, November 14.

Least daily movement, 0 miles, January 6.

Mean daily movement, 128 miles.

Mean hourly velocity, 5.3 miles.

Maximum pressure, per square foot, 23.5 pounds = 69 miles per hour, February 8, 2 A.M., W.N.W., October 21, 12 M., S.S.E.

Precipitation (in Inches).

Total precipitation, rain or melted snow, 45.30.

Number of days on which .01 or more rain or melted snow fell, 126.

Snow total, in inches, 59½.

Weather.

Mean cloudiness observed, 51 per cent.

Total cloudiness recorded by sun thermometer, 2,058 hours = 46 per cent.

Number of clear days, 142.

Number of fair days, 96.

Number of cloudy days, 128.

Bright Sunshine.

Number of hours recorded, 2,401 = 54 per cent.

Dates of Frosts.

Last, April 23.

First, September 22.

Dates of Snow.

Last, April 20.

First, October 12.

Total days of sleighing, 85.

Gales of 50 or More Miles per Hour.

February 8, 69 miles, W.N.W.; March 3, 54 miles, N.W.; April 2, 56 miles, N.E.; September 30, 54 miles, W.N.W.; October 21, 69 miles, S.S.E.

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* Temperature in ground shelter.

J. E. OSTRANDER, *Meteorologist.*
G. W. PATCH, *Observer.*

SPECIAL BUSINESS MEETINGS

OF THE

BOARD OF AGRICULTURE

1904.

SPECIAL BUSINESS MEETINGS OF THE BOARD.

A special business meeting of the Board of Agriculture was held at the Amherst House, Amherst, June 15, 1904, at 7.30 o'clock P.M., First Vice-President Sessions presiding.

Present: Messrs. Allen, Anderson, Bradway, Brewster, Burt, Danforth, Albert Ellsworth, J. L. Ellsworth, Goodell, Gurney, Jewett, Lane, Leach, Mason, Nye, Paige, Perham, Peters, Pratt, Reed, Richardson, Ross, Sessions, Shaylor, Smith, Spooner, Turner, Wellington and Worth.

Dr. Fernald, State Nursery Inspector, gave a verbal account of the work of nursery inspection of the present year.

Dr. Peters, chief of the Cattle Bureau, submitted his fifth semiannual report, which was accepted.

Voted, That the secretary be instructed to prepare and send to the officers of the agricultural societies a circular, asking them to exercise caution in regard to the use of the grounds occupied by tenants; that the nature of the games and shows allowed be strictly within the law; and that the inspectors, in making their annual reports, state in full any illegal features that were allowed on the grounds during the annual fairs.

Voted, That the legislative committee be instructed to consider the advisability of changes in the laws relating to the Board of Agriculture and the agricultural societies.

Voted, That Mr. Spooner be added to the legislative committee.

A special business meeting of the Board of Agriculture was held at the Opera House, South Framingham, Tuesday, December 6, at the close of the afternoon session of the public winter meeting. Nearly all the members of the Board were present.

The gypsy moth committee of the Board presented and read its annual report to the Legislature, when it was unanimously —

Voted, To accept and adopt the report.

SUMMER MEETING

OF THE

BOARD OF AGRICULTURE

AT

AMHERST.

JUNE 16, 1904.

SUMMER MEETING OF THE BOARD, AT AMHERST.

The summer meeting of the Board of Agriculture was held at the Massachusetts Agricultural College, Amherst, Thursday, June 16, 1904, the day following the annual commencement of the college.

The Massachusetts State Grange, the Massachusetts Fruit Growers' Association, the Massachusetts Creamery Association and the Massachusetts Cattle Owners' Association co-operated with the Board of Agriculture, and were represented by many officers and members. Many representatives of other agricultural organizations, granges, etc., were also present, — in all, about 500 persons.

A special business meeting of the Board was held on Wednesday evening.

On Thursday morning, at 8.30 o'clock, Dr. Henry T. Fernald gave a demonstration of preparing and applying the salt, sulphur and lime wash for the San José scale; also of the fumigation of a tree with hydrocyanic acid gas, to destroy the same insect.

At 9.30 o'clock Prof. F. A. Waugh demonstrated and explained the preparation of Bordeaux mixture, and the different effects produced by spraying with different kinds of nozzles and at high and low pressure.

At 11 o'clock Prof. Wm. P. Brooks exhibited three leading makes of separators at the dairy school, showing the method of operating and the action of each; also a demonstration of the Babcock test and of the work of the latest model of Farrington's pasteurizer.

Lunch was served in the new dining hall to more than 300 people.

At 1.30 o'clock Dr. G. M. Twitchell, Augusta, Me., delivered at the college chapel a lecture on "Harness your forces," an abstract of which forms a portion of the proceedings of this meeting.

HARNESS YOUR FORCES.

BY DR. G. M. TWITCHELL, AUGUSTA, ME.

We stand to-day in the midst of a world of transcendent beauty. The Master's touch has covered the earth with a carpet no human hand can equal, decked the trees with garments of beauty, and scattered far and wide the flaming banners of promise for the golden harvest. 'Tis a marvelous unfolding; yet we have not heard the music nor felt the touch of the Artist, because our forces have not been harnessed to grasp the one or hear the other. I would that I might jar the kaleidoscope of your thought so that the prisms would change form just a little, and let my simple story take possession.

Growth never follows the single thought of revenue. The man who measures his work solely by the possible output, and lives in that atmosphere of utility, is a plodder; and, while he may accumulate, his poverty increases. New England agriculture suffers because the conscious and unconscious influence of the age magnifies the financial issues of the farm. It is the man who grasps large problems who succeeds; that one whose thought is entirely concerned with details is buried under a mountain of difficulties. Either the man or the farm will be master.

The agriculture of the twentieth century needs to be keyed to a more exultant note. I do not forget the toil, the difficulties, which have encompassed and still surround the farmer; but so sure as harvest follows seed time must the agriculture of the next twenty-five years keep step with the industrial life, or it will be lost in the great forward movement of the century. Your forces must be harnessed for mastery, if it is to be demonstrated, as it may be, that this industry offers as good opportunities as any in the world for skilled fingers; that here is the best opening for intelligent research; and that the man who tills his farm by the best light of the present age is to be master of the situation, because of that free, full life in touch with nature.

Stop measuring the industry by the failures. New England has been cursed by the cry of abandoned farms, while in every valley, village and town there are abandoned industries never mentioned. Ninety per cent of the business men fail, while less than five per cent of the farms are lost. More than ninety per cent of the legal profession struggle for a subsistence, yet the farmer's table is always loaded. The average salary of your clergymen in some of the larger denominations is less than $400 yearly, — not enough to cover rent, fuel and the products of your poorer farms. Dignify the industry, and it will dignify the man.

Why are not the study and investigation which steadily build up a herd as ennobling as that which sustains a factory? The man who in the process of the years develops such a herd, every one capable of producing ten thousand pounds of four per cent milk, is as great an artist as he whose canvas is hung on the walls of the noted galleries. The captains of industry have been heralded by public sentiment; but not all of these giants of finance have added to the essential comforts of the world as have the men whose toil has opened the door to the agricultural possibilities of the present season. The real captains of industry are not those who manipulate stocks and bonds, but those who take the forces of nature and work them over for the blessing of man. In both cases these men succeeded only through the harnessing of their entire forces for the conquering of the obstacles in their paths.

Agriculture as an industry has been minimized until the scrubby oaks tell the story of neglected acres. Massachusetts has agricultural possibilities beyond the imagination of the most enthusiastic, but it will never pass the bounds set by its champions. It is all false that New England must be given over to other industries. The heaviest burdens are those made by would-be friends. Harness your forces to make this the great agricultural State of the east, and the walls of your college are not broad enough to hold the young men who will knock for admission, and ask for the benefits of the thorough preparation possible here.

Paradoxical as it may seem, one of the greatest obstacles is the multiplicity of helps, creating a spirit of dependence, and preventing that self-poised consciousness of purpose necessary everywhere for success. It is the man who thinks that grows. More than a machine is demanded; and to utilize these helps coming from every hand, the man must be conscious of a great purpose and a continual struggle. Our agriculture is to be measured finally not by the magnitude of the crop output of the farms, but by the quality of men and women developed thereon. Measured by this test, it overtops all other occupations. The history of civilization is a story of struggle, from that day when man was sent forth to have dominion; for that dominion was to be mental, not physical. Not in concrete masses are we to witness an uplift, but by and through the active efforts of each worker. What marks the difference between the men of to-day, with their multitude of helps, and the man of a century ago, digging out the knotty problems alone by the light of his tallow dip? Out of their deprivations ambition was born; because of their necessities, zeal was fired; fettered by poverty, they harnessed their forces and used their brains until the light came, and they did grand service for humanity. An easy road never developed muscle. In the future, the whole man enters into the account. Every blow struck must tell of the intelligence of the striker, every day's work speak the thought of the laborer, or loss will be inevitable. Success lies not in doing something, but in doing that something well.

Men and women must be made to feel that it is not respectable to be idle, for in so doing they are losing not only the opportunity but the power to be something in life.

The shorter hours of labor will be a curse unless the extra leisure is utilized for development. Only true metal has the right ring, whether on the counter or in daily life. We never get more out of life than we put into it. What the world needs is individuality; and individuality is born alone of necessity. The force of opposition, the press of adverse circumstances, the struggle for mastery through the complete harnessing of all the forces, — these are the factors which call out the talents and set the seal on the forehead of the man. Life may be made so easy that self-culture and self-reliance will not be considered the all-in-all in the making of the man.

The individual without imagination is to be pitied. The activities of the present demand men who see and think and act. We must be inspired by noble and real convictions, and plant ourselves by the side of those declared by Emerson to be "appointed by God to stand for a fact." Organization can do much, but only as individuals use it for the upbuilding of self through harnessed forces. Perfect your organizations for greater service. Put into them all of the individuality possible. Keep clear the burden of individual responsibility, and, above all, the certainty that there is to come in the near future the greatest uplift ever realized in New England agriculture, and that all these agencies are to play an important part in the forward movement of the hour.

We boast of what the grange has done, but what concerns us most is what it is to do. Where it is strongest, there your agriculture is most active. It is an agricultural organization, founded to promote the industry, and its advancement must be the controlling purpose of the patrons. Whatever best serves the country towns best serves the farms; whatever makes active the desire for larger crops and herds increases the permanent wealth of the State; and whatever leads to a clearer insight into the problems of growth adds to the prosperity of all. The grange must be more active along educational lines for the great majority. Systems must be reconstructed to aid the many, not held for the benefit of the few. More pride must be stimulated in rural life. The defacement of farm property must cease. God never made the rocks and trees for advertising bill boards. Here is work, hard work, for the grange; and only by seizing these larger problems and cementing the members for earnest effort can it merit a claim for public recognition. More work and better work, deeper resolves for the future as well as rejoicings for the past, the building of a positive, earnest, persistent, aggressive agricultural sentiment, is to be the field of operations for the patrons of husbandry; and out of these will come a volume of influence which will insure that essential support, on every hand, necessary for the best advance of New England agriculture.

PUBLIC WINTER MEETING

OF THE

BOARD OF AGRICULTURE

AT

SOUTH FRAMINGHAM.

DECEMBER 6, 7 AND 8, 1904.

PUBLIC WINTER MEETING OF THE BOARD,

AT SOUTH FRAMINGHAM.

The annual public winter meeting of the State Board of Agriculture was held at the Opera House, South Framingham, on Tuesday, Wednesday and Thursday, December 6, 7 and 8.

Secretary Ellsworth called the meeting to order at 10 A.M., and introduced First Vice-President Wm. R. Sessions as the presiding officer.

Prayer was offered by Rev. Dr. Charles H. Daniels.

The CHAIR. We are here upon invitation of the Middlesex South Agricultural Society and the people of this town. A representative of the people of Framingham, Mr. John M. Merriam, has a word to say to us.

ADDRESS OF WELCOME, BY J. M. MERRIAM, ESQ.

Mr. Chairman, ladies and gentlemen: At the request of a committee from the Framingham Board of Trade, and in their behalf and generally in behalf of the people of Framingham, I shall endeavor to bid you, members of the State Board of Agriculture and the many visitors who will attend these meetings, a most cordial welcome.

The people of Framingham are distinguished above their neighbors by two very commendable characteristics. In the first place, every Framingham man is, and always has been, of very modest disposition. There is an old quotation which seems to have special force at this time, "Modest men are dumb." In keeping with this modest disposition, they have in this instance passed over the officials of their town, especially their capable and respected representative in the General Court, Mr. Samuel O. Staples, who, by reason of his official position as president of the Middlesex South Agricultural Society, and his great zeal in the promotion of these meetings, might most properly speak these words of welcome, and have come to me, an obscure and unskilled farmer of Sherborn, and have requested me to be their spokesman.

I presume the real reason for this selection is not any special grace or dignity which they feel that I can assume in extending the hospitality of Framingham, but the desire to compliment me upon my recent calling. I have noticed that whenever a professional man undertakes any farming enterprise he is made the object of special congratulation. He also seems to be a special cause of amusement, not only to the professional men, but also to the farmers. I presume that the people think that now he may begin to learn something, and it usually is true; for I, for example, have learned that it takes a pretty good law practice sometimes to carry on a New England farm.

In the judgment of these good Framingham friends of mine, this occasion, I suppose, requires the peculiarly warm-hearted and whole-souled welcome which only a farmer knows how to give; and so far as I can, therefore, I will give you a farmer's welcome, although I hope no one of you will judge me harshly if I betray a woeful ignorance of just how to do it.

The second distinctive characteristic of Framingham people is their sincere and abundant hospitality. They are ready at all times to welcome all good things and all good people. The Chautauqua assembly, the Salvation Army, the camp meeting promoter, — all have learned of the hospitality of this town; and our Commonwealth, too, has shared it many times. Only a few years ago, when the troops of Massachusetts came to Framingham, they read on the arch that was placed over our principal street, "Welcome to Massachusetts Volunteers;" and as they departed, they read the benediction, "God be with you till we meet again."

This obligation to welcome all strangers is a part of the heritage which came from old Governor Danforth, when he bequeathed the name of his former home in England to the new settlement in which he was interested in New England. This name does not denote — as its modern corrupted pronunciation may lead you to believe — that the chief occupation of the people in this town is, or has been, the framing of houses, or of pictures, or even of statutes. This name is not Frāmingham, but is Främingham. This difference in the pronunciation is not mere affectation. The older pronunciation should be encouraged, both for historical accuracy and particularly in order that the true meaning of the name may not be forgotten. We are told that the early meaning of the English name Framlinghame is "Stranger's Home," — a refuge, a haven, a home for all newcomers. This very name, therefore, which never yet has been duplicated in the entire United States, requires that we meet you as you come among us with a smile of welcome and a hearty hand grasp of cordial greeting.

We welcome you first as individuals. Many of you will find old friends among the people whom you will meet at these meetings and on our streets; and those of you who do not know us now as old friends, we trust hereafter in recollection of these meetings will permit us to greet you as friends.

But we welcome you even more cordially because you come to us as representatives of the great agricultural interests of Massachusetts. In some respects we have outgrown the simpler conditions of an agricultural town. Many of our people are engaged in other enterprises, and the signs of activity in our factories and on our streets give evidence of enterprise in other pursuits. But we were one of the earliest farming districts in the colonial period. Before our town was incorporated, this section of southern Middlesex was known as Danforth's Farms. Probably over these level fields the Indians had their favorite hunting grounds. Undoubtedly, season after season, they enriched the land with the fish which they found in these ponds and rivers, and planted and harvested the Indian corn, — the yellow maize, so fittingly described by one of the leading American poets, whose frequent presence in Framingham we so joyfully welcome, Miss Edna Dean Proctor, as Columbia's emblem.

Out of agriculture, however, the sterling New England character has been formed. It was life on the New England farms that developed the wonderful spirit of independence and progress which has made Massachusetts the truest example of an enlightened Commonwealth. There is urgent need that the people of the present age should not despise the day of small things, should not look with contempt upon the humble but sturdy calling of those who cultivate the soil. On the contrary, every possible effort should be made to dignify that calling and to promote a more abundant return to those engaged in it.

A prominent clergyman, in his Thanksgiving address in Boston a few days ago, spoke these words of warning, — and I wish I might have your undivided attention while I read them: "The spirit that owned in all the earth no King but God still lives, — but where? Not in its old seats. Not in the farms of New York, and the hills of New England. It needs no didactic article to warn us of the change. Deserted farms! Empty churches! Utter ignorance! Vice! It needs no stories of Miss Wilkins to emphasize the dreary barrenness. They are there, — the shells of Puritanism, white, hard, narrow, lying dead and bare upon the beach, and the tide is out. Ashes left by an onward-sweeping fire, — ashes, cold, and dead, and gray. I can take you to valleys shut in by the old New England hills where there is more rottenness than in the New York slums. Nothing but dregs of life, reeking with impurity!"

This seems almost like the lamentation of a Jeremiah. We must heed it, although we dispute it. We are not ready to accept these words except as an exaggeration and as a warning. Although there may be sad exceptions, yet the words of the old Roman Cato still are true: "The agricultural population produces the bravest men, the most valiant soldiers, and a class of citizens the least given of all to evil designs."

No board of officials has, it seems to me, a higher and a more important duty than that which belongs to the State Board of Agriculture, — to counteract in every way possible the conditions that tend to make life on a Massachusetts farm a lonely routine of toil, of monotonous drudgery and of meagre return, and to bring into that life all that can be brought into it of thrift, of progress, of energy and of prosperity. We believe that this is the real end for which you strive, and with our words of welcome bid "God speed."

But last of all we welcome you as representatives of the Commonwealth of Massachusetts. The Commonwealth is the mother of the many towns within her borders. Our municipal existence is derived from the Commonwealth. She has defined our powers and instructed us in the exercise of them. We have no prosperity but what is her prosperity, and no misfortune in which she does not share. We welcome you, therefore, as a child would welcome the coming of a parent interested in our progress, and ready with wise counsel and helpful suggestions to aid us.

And with our welcome we wish to express our delight with the programme of your meetings. The lectures cannot fail to be a far-reaching help, not as discussions of theory which will interest a few, but of practical suggestion of every-day importance to many.

We also ask you to stay with us through all the meetings, and longer, if you wish; but especially we urge you to visit the farm of our well-known townsman, Mr. N. I. Bowditch, on Thursday afternoon. We want you to notice the progress exemplified in a comparison between Danforth's Farms of 1690 and Bowditch's farms of 1904. You will then realize that the world moves, and moves onward even in Framingham Centre. Here you will find no shells of Puritanism lying dead on the tide-deserted beach, but paths dropping fatness; pastures clothed with flocks; valleys covered with corn.

And now, on behalf of the people of Framingham, I bid you welcome, and I extend to you the freedom of the town.

RESPONSE FOR THE BOARD OF AGRICULTURE, BY FIRST VICE-PRESIDENT WILLIAM R. SESSIONS.

I see the secretary and committee have put upon the programme a reply to this address of welcome by your vice-president. I feel entirely unequal to replying to the elegant address which we have heard and the cordial welcome which we have received.

The Massachusetts Board of Agriculture is here for a purpose, as it has been annually, in its winter meeting, for many years past in different places. The effort of the Board through its committees has been to hold these meetings in various localities from year to year, so that all the people of the State might have equal share in the benefits which may come from the lectures.

We come to Framingham this year through the invitation first of the Middlesex South Agricultural Society, and then of its people; and we are glad to come, having been here before in years past. We are glad to come because Framingham is a town of which the people of Massachusetts are proud. The old historian said in 1837 that the soil of Framingham was well calculated for the production of rye and corn, and that every acre was susceptible to cultivation. Framingham is a unique town in that respect.

The representatives of this society on the Board of Agriculture have been among the most useful of its members, and we are glad to come here in recognition of the efforts of the men whom you have sent as delegates to the Board of Agriculture. The first was Wm. G. Lewis, then came Henry H. Peters, Elias Grout, John Johnson, Jr., J. N. Sturtevant, Elijah Perry, Thomas J. Damon, S. B. Bird, and Isaac Damon, the son of Thomas J. As we look further at the record of this magnificent county of Middlesex, and the men she has given to agriculture, we are still more gratified to have this winter meeting in this place. Among those names you will find Simon Brown, E. W. Bull, John B. Moore, Asa Clement, Louis Agassiz, Leverett Saltonstall, James F. C. Hyde, E. F. Bowditch, A. C. Varnum, W. W. Rawson, N. S. Shaler, N. I. Bowditch, E. W. Wood and William H. Spooner. These men are the Romans at work for the agricultural interests of Massachusetts.

As the speaker who gave us welcome has well said, the programme is a good one. The lecturers are of more than local reputation, some of them of national reputation; and the lectures to which the Board of Agriculture invites you to listen are such as we believe no Board need be ashamed of. But you came here to see this programme carried out, to hear these lectures and to enter into the discussion which will follow them, and it would not be fitting in me to take more of your time.

Thanking the representative of Framingham for his cordial welcome, the people of Framingham for the welcome extended through him, and the members of the Middlesex South Agricultural Society for the invitation extended to us, we will proceed with the programme.

The first lecture is on a subject which touches the farmers of Massachusetts more closely, perhaps, than any other agricultural subject of the day, — "The producing and marketing of milk." Every town in the State is interested in dairying, and every city is interested in dairying, because of its dependence on this branch of agriculture for its very life.

We have for a lecturer a man who has spent his life in the business, who has made a magnificent success in the production of milk, and in the last few years has had great success in gathering milk and sending it to the consumer, as the manager of the Springfield Co-operative Milk Association. His work is appreciated, I assure you, by the people of Springfield and vicinity. I have the pleasure of introducing to you Mr. Frank B. Allen of Longmeadow.

PRODUCING AND MARKETING OF MILK.

BY MR. FRANK B. ALLEN, LONGMEADOW.

When we note the multiplicity of ways by which milk finds its way into our every-day diet, — that there is hardly a man, woman or child who does not partake of it in some form, — it is then and only then that we realize what a necessary adjunct milk is to our existence, and what a blessing the cow is to humanity.

There are but very few people who realize the amount of capital, both in dollars and nerve power, it takes to produce milk. The majority of people think that because it is liquid its place is alongside of water, — a very necessary article in our every-day life, but rather inexpensive; in fact, there are not a few farmers who produce milk who know what it costs to make a quart of milk, or are informed as to how many of the cows in their herd (if any) are paying expenses or running them in debt, or which ones are making a profit. I think there is no business that requires more persistent study, careful thought and the exercise of good judgment than the production of milk, where it is carried on to make a profit, — the choosing of a farm, the arrangement of buildings, the choice of a herd, the rations, the care of the milk, and, last and most important, the marketing of the product. No movement or enterprise, no matter how great or how small, has ever amounted to anything unless it had something behind it to make it go. Brains, money, industry, economy and a genius for organization are some of the most common elements regarded as essential to success; and to these, for the farmer who is producing milk, I would add patience.

What we as farmers need is more true knowledge of our work; just because a farm has the reputation of keeping twenty head of stock, the owner does not feel obliged to keep that amount of stock, when in reality he has only feed enough to keep ten well. Knowledge is power, but the mere possession of knowledge is not power; but knowledge with action is power, — it is essential to success in any business to have knowledge. Senator Hoar, in his advice to a young lawyer, recommended that he study continually, not allowing his practice to interfere with his deeper research into law. Such advice is applicable to the producer of milk, who should ever be anxious to raise his profession to a high standard.

On no individual of the animal kingdom has the dominant hand of man left so clear and lofty a record, and in no case has nature been more generous and helpful, than in the gradual development of the cow. The lowlands of Holland have given us the generous milker, the Holstein; Switzerland and Scotland, the mountain breeds; and the Channel Islands, the delicate, fawn-like Jersey. When we think of what man started with generations ago, — a long-horned, wild-eyed, long-legged, light-quartered animal of the bovine tribe, — it is then that we commence to realize the great work man has been engaged in all these years, until now we have such magnificent animals as are exhibited at our State fairs and at our national exhibitions. It has from the start been a survival of the fittest, and we are in all probability yet far from the finish.

It is a growing tendency among dairymen of New England to work their herds into pure breed cattle. Some commence with only the bull pure breed; it will not be long before they will want a registered cow to match, then one or two more; soon they will have a pure-bred herd.

If the breed chosen is the right one for the object sought, it will soon be found that the more of this blood the herd contains the better. Starting with half-breed cows came the offspring of pure-bred bulls and dams of mixed and uncertain blood; the next grade, three-fourths pure, will prove better dairy stock, if the bull is what he should be and the increase has been culled. Successful dairying has proved that the greater profit comes from the best cows, whatever their kind. This is true of pure-bred or registered stock, as of common cows.

A dairyman may start with nothing but grade cows of only fair quality, and, by simply purchasing a dairy sire of excellent quality, have a fine grade dairy herd in a few years. Too much stress cannot be put on this point; and money and time spent in finding an excellent sire will prove a remunerative investment. The heifer calves from the best cows should by all means be raised, — the method that is still quite largely practised in some portions of our State; but there are a great many calves raised to-day that ought not to be raised, and from them we get the inferior cows. In order to get good cows, take good care of the heifers; they should be kept growing from the time of birth until calving; give them feed that will properly nourish and develop them.

ESTABLISHING A DAIRY HERD.

This can be accomplished in two ways; it may be done by buying or by breeding, and these two methods may be combined. The purchasing plan is more applicable to those who produce milk for a city supply. Cows are bought when mature, and, at their price, judging exclusively by the milk yield, are highly fed so as to keep them steadily gaining in flesh, and are sold usually to the butcher as soon as they cease to be profitable as milkers. This system requires large capital and the best of judgment in buying and selling, and needs experience.

The other method is to begin with a few well-selected animals as a foundation, and build up a herd by judicious breeding and natural increase. This method takes time, but it is far safer and more satisfactory in its results, and it must be recognized as a higher grade of dairy farming. With a herd formed, begin at once to improve it by breeding and selection. Sell without hesitancy any cow which proves unsatisfactory, and replace her by an animal which will raise the average quality.

THE SELECTION OF A COW.

If one would run a dairy for profit, too much consideration in selecting a cow cannot be given.

There is divided opinion as to the kind of cow which is most profitable. Some prefer a "general-purpose" cow, being a member of a specially developed milk-producing family, from one of the beef breeds or grades of such stock. An animal is thus secured which is easily kept in good flesh, has a large frame, and fattens soon when not milking heavily; such a cow has large calves, profitable for veal. Such an animal may not be so productive while in the dairy, but their meat-making may make up for it.

There are two or three of the established breeds of cattle which are claimed to possess combined qualities for meat and milk; but if we are to run a dairy, let us get the type especially adapted to dairy purposes alone. This class includes many breeds, all having the marked characteristics which distinguish the milk producer. Such breeds are so profitable as milkers that their beef-producing quality and the final disposition of the carcasses may not be taken into account. The calves have a value only so far as wanted to raise for the dairy. Every dairyman must decide for himself which of these lines of policy should be pursued. It is very essential, if you wish to succeed in the dairy business, to make a wise selection of the cow, or the foundation; whether one should buy, breed and feed his cows, having in view only their dairy products and capacity for reproduction, or whether he will find it more profitable to include the items of beef, must be governed by home conditions.

There are a great many varieties of dairy cattle from which one can select breeds well adapted to the special needs in view. Some dairy cattle are noted for the quantity of milk they produce. If these cows will give 4 per cent milk, then they are the kind the writer would recommend; but we all know that when we get a cow that will give a large flow of milk, — from 18 to 25 quarts a day, — she is quite apt to give a light percentage of butter fat, some as low as 2.1 per cent. Other dairy cattle are noted for their high quality or richness of their milk; these make butter producers. What we want is a combination of quantity and quality, which, under some circumstances, is especially economical.

Some suggestions to guide in choosing a good dairy cow: she must be of fine organization; her muzzle fine; her eyes large and clear; her neck long and thin; all her legs well spread; her pelvis large; her back inclined to be sharp; a long, slim tail, with a heavy bush, goes with a good cow. A heavy milker must have a large udder, but is rather broad than long. Such an udder should have short hair, and when milked should be shrunk in size, and the skin should hang loosely over the surface. The shape and set of the teats is an important consideration in buying a cow; an ideal-shaped teat is long and rather slim.

We must set our standard high for a good cow. By keeping a milk record of the individual cow for a season, and by use of the Babcock tester to determine the percentage of butter fat, it is quite easy to find out the cows that will come up to your standard. We know of dairymen who keep one-half of their herd at an actual loss; possibly the whole herd is making a little profit. Some are satisfied with the returns, though small; and others are complaining about the milk business, — how it is impossible to make ends meet with the prevailing prices, and so on, — when the fault is not in the prices, but in themselves; content to keep worthless cows, and not taking any steps to ascertain which they are.

If a man will take pains in selecting, the standard will be gradually raised each year, weeding out the poor ones and breeding only from the best. Do not condemn a heifer with her first calf, if she is a promising individual, if she does not do well; but if she continues to do poorly, on second lactation, she should be kept no longer. There is a vast difference in the efficiency and profit derived from individual dairy cows. Cows of excellent quality can be obtained at fair prices in nearly all sections, but you will have to take some time and pains to ferret them out.

SUITABLE BUILDINGS AND SURROUNDINGS.

The old style of keeping the cattle, manure, crops and farm implements all under one roof, can no longer be regarded as perfection, no matter what the arrangement or how thoroughly ventilated the buildings may be. The danger of loss by impairing the health of the stock and damage to fodder is too great. I am in favor of the style of barn where the cows are in an annex by themselves, with no manure cellar under them. Costly barns or stables are not essential to the production of clean milk or to the maintenance of a dairy herd at its highest efficiency. To obtain the best results it is important, however, that the cows be kept comfortable at all times. To do this, there are several essentials with which a barn must be provided. It must be constructed and kept in repair so that the roof will not leak, sides that do not allow the wind to blow through, and doors that will close tightly. Have the platform fit the cows; if it is too short the cows cannot lie down comfortably, and if too long the droppings will fall on the rear of the platform and the cows will become soiled when lying down. It is of the utmost importance to keep cows clean. It is well to have the platform gradually taper to six or eight inches shorter at one end than the other, as cows vary in length. When large herds are kept, the platform on one side of the barn may be longer than on the other side, and the cows arranged accordingly.

Have the barn on an elevation, if possible, so you can get good drainage. The barn yard should be located on the south side of barn, the ground inclining to the south-east. This should be well drained, and should have a hard surface either of cinders or gravel, so that there will be no mud or manure for the cows to get into. The barn should not be sufficiently near the house to cause unpleasant odors, or to endanger the one should the other take fire; it should be as close as possible, and yet avoid these drawbacks. Any one who has done farm chores in rough weather, when the thermometer was 30° below zero, will appreciate the saving of discomfort by not having too long a distance to go from house to barn, — in fact, to any other farm buildings.

Light and Ventilation.

These are easily obtained, and, although absolutely essential to the best health of the herd and the economic production of clean milk, they are rarely appreciated. Two things almost lacking, or at least inadequately supplied in dairy barns, are light and pure air. As we ride through a dairy section we find very few barns well lighted; many barns are not provided with any system of ventilation whatever, as but few dairymen realize that pure air is just as essential to the economic production of untainted milk as is the food a cow consumes. Digestion and assimilation, like the burning of coal in a stove, are processes of combustion; the stove may be filled with coal, but if the drafts are kept tightly closed the coal will not burn, as sufficient oxygen is not provided. Neither can a cow's feed be properly digested and assimilated without an abundance of oxygen; and, unless this is supplied, a great waste of food, as well as impaired health to the cow, will result. Have plenty of windows, so as to admit a flood of sunshine. The barn should be light, clean and sweet, free from odors, and so arranged as to secure the sanitary requirements and the quiet so essential for dairy cows.

The number of feet of air space that should be allowed for a cow is of little consequence in comparison with the more important question of ventilation, or change of air. One writer thinks that each cow should be supplied with 31,540 cubic feet of air an hour. The size of the ventilating flues will depend on the number of cows in the stable. To provide air for twenty cows, a flue 2 feet square will be sufficient.

Whitewash, — its Advantages.

The stable should be whitewashed at least twice a year, — spring and fall. The interior of the stable should have a smooth surface; ceiling should be tight, excluding all chaff and dust from above. In our travels among farmers of the State, how many stables do we find whitewashed? Do we not find most of them with a few boards laid overhead at irregular intervals, with hay hanging through, and with the sides and ceiling in no better condition, cobwebs and dust hanging? You cannot properly whitewash these stables. It makes the stable much lighter and sweeter, and serves as a disinfectant. Dry lime sprinkled in stables serves as a deodorizer.

FEEDING.

A cow may inherit the best of constitutions and milking capabilities, but the value of these depends on the conditions under which she exists. Not only is it impossible for her to make something out of nothing, but her profit at the pail will be in proportion to the judgment exercised by her owner in those matters which directly affect her yield of the day or the season. Knowledge and care in feeding must accompany skill in breeding, or the latter will be of little service. A very large proportion of the food of the cow is grown on the farm, and of this again no small share is consumed in the growing state, or as green fodder, hay or silage. It is very essential to have clean pastures. The true grasses and leguminous plants may cause changes in milk quality by their many mixtures, proportions and growth, but they will not interfere with the dairy processes or give to the products ill qualities; but many plants which we may call weeds include some which are dangerous to the health of the cow; others, more numerous, which flavor milk undesirably and are the cause of much mischief. The question may be asked, Do cows eat any appreciable proportion of such plants? The occasions known may be few in which the mischief is recognized and traced to some particular plant, but such do occur often enough to make the matter one of great importance; and I believe that a very considerable amount of harm is done daily by such weeds as are incapable of giving a distinctly bad flavor to milk, but in these many kinds combined to give one generally inferior. If a weed is a pest in the corn field, it is a much greater one in pastures, where it not only takes the place of a better plant, and hinders the superior growth around it, but actually does direct damage to the dairy goods. Weeds are the natural and almost inevitable consequence of neglect. There are few pastures which can keep sweet and free from such trouble by the mere force of natural conditions. Draining and manuring can do much in reducing the miscellaneous plants to small numbers, and a constant war against them should be maintained. You can increase the milk yield by feeding grain to the cows in summer; it helps out the pastures and keeps the cows in better flesh.

SOILING.

The advantages of soiling over pasturage are so great, especially where dairying on high-grade land, that every dairyman should study the question of adopting this system. Much depends on cost of labor; it may be profitable to practise partial soiling where it will not pay to do more. It has been shown that by feeding cows wholly on green forage crops in the stable, from two to five times as much milk can be produced from an acre as from pasturing the same land. Many farms contain many acres of excellent pasture land that cannot be tilled, but for tillage land the profit in soiling is great. Many more cows can be kept on a given area, and the productive capacity of the land may be rapidly increased. There is a great saving of manure, which is a great gain in soiling. For this system of feeding stock a variety of green crops is necessary, grown to come to best feeding conditions in well-arranged succession throughout the growing season. It needs a good deal of skillful management to bring on the crops at the right time in proper succession and sufficient quantity. One point gained by soiling is the saving; the food expended by the animal in its exertion to procure its food at pasture; but moderate exercise should be given. The herd should be turned into a small lot or yard each day, or, better, at night. The feeder must study each cow. Cows differ in their tastes and in their requirements in the way of food. Some cows need more feed than others. To feed rightly requires a lot of common-sense on the part of the feeder. Ensilage fed judicially is no detriment to a gilt-edged product. I shall not attempt to set forth any balanced rations here, as the feed bulletins from our Agricultural Experiment Station can do it much better that I can. Feed makes a great difference in flow of milk, but not in butter fat. In order to get that, you must breed for fat, — not feed. The percentage of butter fat is practically fixed in a cow at her birth.

WATER.

Water of good quality and in plentiful supply is more necessary to milking cows than to any other stock. Beyond what is required for the use of the system, the cow must have enough to maintain the natural proportions of her milk. Under natural conditions she will not use more than is good for her.

The quality of the water is of the utmost importance. Cows prefer soft to hard water, and that which has "the chill off" to a colder supply.

It is well to have water in cups in the manger, where the cow can drink at her pleasure; there is then no danger of her drinking too much; she will drink often, and will thrive much better. It has been found that the average milch cow requires about 81 pounds (nearly 10 gallons) of water a day; while in milk cows need much water.

MILKING.

We come now to a very important part of the business of producing milk. No matter how fine the herd is, or how well arranged the buildings are, or how well we have cared for the dairy herd; unless there is cleanliness in milking, the product is inferior. In the production of milk for direct consumption it is imperative that the udders be cleaned before milking, as it is from soiled udders that milk as ordinarily produced gets the greatest amount of contamination. It has been found by experimentation that most of the filth and bacteria that find their way into milk come from the surface of the udder during the milking process. To prevent this contamination the loose dirt should be brushed from the sides and bellies of the cows, the udders should be wiped off with a damp cloth, and the milkers should be required to have their hands clean and have on a clean suit, — not necessarily white suits, but clean; cleanliness is conducive to health. The cow should be brought in and milked with gentleness and quiet, for excitement is not only injurious to them, and liable to reduce their yield, but it also affects the keeping quality of the milk. Never allow a milker to wet his hand with milk, even if his hands are clean; it will damage the milk.

The cow is an animal of regular habits. She expects to be milked at a certain time, and becomes more or less uneasy if she is not milked at the same time each day. A change of milkers may result, for a few milkings, in a reduced yield or in milk of poor quality. Milk is of course subject to the laws of density before it leaves the cow; and we accordingly find that the "fore milk" (first drawn) and the "strippings" (last drawn) differ greatly in the proportions of fat; the latter having most, because the globules have remained nearest to the surface of the stored milk. The globules of the fore milk are mainly small ones, the largest being found in increasing numbers as the removal approaches completion. The strippings has five or six times more fat in it than the first pint of fore milk, so it is very essential to have the milkers strip the cows thoroughly; too many milkers are not careful enough on this point.

Cooling Milk

No dairy is complete unless it has a room apart from the stable and barn where the milk can be cared for. As soon as it is drawn from the cow it should be removed from the stable to the milkhouse, and then aerated and cooled to 50° F., or below, if possible; the best process is to run it over a cooler. All milk should be aerated, no matter how small the dairy is; it will pay the producer, for it makes the product much more palatable, and gives it a clean, sweet taste.

From the cooler the milk should run into a mixing can, so that every can in the dairy will be of the same quality; and constant uniformity of the milk makes it much better for infant feeding than the milk from a single cow, as the milk from one cow frequently varies greatly from milking to milking. Where an aerator is used, it must be done in a pure atmosphere, free from dust. The sooner the milk is thoroughly cooled after it is drawn from the cow, and the lower temperature to which it is brought, the better. When the milk is at the temperature at which it is drawn from the cow, the bacteria that get into the milk when milking develop very rapidly; but as soon as cooled to 60° F. they develop slowly, and if cooled to 45° their growth is almost entirely stopped. Milk cooled to 45° as soon as drawn, and kept there, will keep sweet and in good condition for a long time.

On a large proportion of our dairy farms many of the fundamental principles spoken of under the foregoing heads, which would be observed in producing pure milk, are almost entirely overlooked. This is usually due to lack of appreciation of their importance more than to intentional neglect. In most cases, bad conditions are promptly improved when their dangers are known. More time must be taken by the producer of milk to get the special knowledge that is necessary in conducting a dairy; by adopting as many sanitary methods as possible, and gradually increasing them, a steady progress will be made and conditions will improve. The methods commonly employed in the production of milk are so faulty, and the evils resulting from the use of impure milk so numerous, that any one interested in the public welfare should be anxious to bring about an improvement. We are aware of the amount of attention the water supplies of the cities and towns of the State are receiving; large sums of money are spent to keep them pure and of good quality. It is encouraging to note that there is more attention being paid to the milk supply, which is of even greater moment than the water supply, especially to children.

MARKETING OF MILK.

When we note that there are in the United States 19,000,000 cows, and it is estimated that they produce 67,640,000,000 pounds of milk in one year, and about one-third of this amount is required to supply the people with milk for use in the natural state, or 11,275,000,000 quarts of milk to be marketed, — is it not a question worthy of our consideration?

Now, the question the farmer asks is, How can I sell this product to the best advantage? There are three ways for him to dispose of it: one is to handle it himself, with his own teams; another is to sell it to the middleman; and another is to pool in his product with his neighbors, and make a partnership under the co-operative system. Whichever plan he adopts, he finds that he is in company with some one; if not with the middleman, he is with the consuming public. It is policy for the seller to find out just what they want and make the goods they call for, and exact of them a price that will remunerate him for his efforts. It ought not to be forgotten that it is a poor plan in business for the seller to ignore or treat as of small consequence the wishes or even the peculiarities of the customers. Public interest in the quality of market milk is increasing. Milk consumers, physicians and progressive milk producers and dealers seem to appreciate that there is the greatest variation of quality and wholesomeness in milk sold, and that it is highly important for this article of food to be always pure.

Milk is a valuable product of the Massachusetts farms, and on some farms the only article produced. With the growing demand for milk and cream in our large cities and towns, the problem that confronts us to-day is, Where is the milk all coming from to supply the demand? With the express freight and trolley express, they in a measure help solve the problem; but in order to get a supply the contractor is obliged to go back into the country several hundreds of miles, and in so doing buys the product which formerly went into some creamery, causing a complete change in the method of handling the product of the dairy in that vicinity.

There are strong arguments in favor of selling milk, rather than selling cream to a butter factory; and, *vice versa*, equally good arguments in favor of selling cream to factories, over selling milk to be shipped to large centres of population.

The location of the producer's farm must be taken into consideration; the price of land; amount of good pasturage; easiness to get his farm products to market.

We know that where milk is sold continually off the farm there is no fattening of hogs, no raising of young stock; pastures are not as well kept up, having no dry stock to run on them; and it is a heavy drain on the farm, and must be replaced by large expenditures of money.

But to the majority of farmers there is more money in selling milk than in the selling of cream for butter. The creameries of the east have now to compete with the creameries of the west. Rapid transportation of goods from the west in refrigerator cars makes it possible to get goods delivered from Iowa into our markets of the east in as good condition as goods shipped from our eastern creameries; and to compete with our western neighbors, who make the market price, we must sell at or near their prices; then often prices run very low, especially in the months of April and May. Taking the price of a pound of butter, and finding how many quarts of milk it takes to make that pound of butter, we will find that milk disposed of in this way has not brought very much of a price, — possibly not over one and one-half cents a quart; yet these farmers have more assets than simply the price of a pound of butter, — possibly a large yard of fat hogs or a fine drove of well-bred heifers growing on to be sold when matured into cows; they also have a large amount of manure which goes back on to the land, and so keeps up the fertility of the land.

Each farmer must be his own judge, after taking into consideration his surroundings, of which is the wisest way for him to dispose of the product.

The Farmer may peddle his own Milk.

There are some advantages in this plan, when the farmer is situated near small towns and cities, when he can make a trip from home and arrive in time to supply his trade. If the producer has some one he has confidence in, either to peddle or to see to the farm duties when he is away, then he will be able to get all there is of profit in his milk; but if he has not some such person, he had better sell his product in some other way. I have always noticed that the farmer who is disposing of his product direct to the consumer exercises more pains, both in the quality and care of his milk, for it is then he sees the importance of having the milk in good condition and of high standard.

SELLING TO THE CONTRACTOR OR MIDDLEMAN.

This method of disposing of milk is the one most largely used in our State; and many of our large contractors have to go into Vermont, New Hampshire and Maine for a large part of their milk supply. Many times the farmer thinks he is oppressed by the rigid demands of the contractor in regard to the care of the product, — temperature that the milk must be kept at and delivered to the station, kinds of feed he may and may not use, and many other requirements. The producers in general think that many of these points are unnecessary and unreasonable, but they are not, — they are absolutely essential to the business; and if I should comment, I should say that they are not as exacting as the circumstances demand. If the producer would stop to think what the milk has to go through: twenty-four hours old before it reaches the contractor, and then it has to be recooled and sometimes pasteurized, and held until the next morning, and put out to the trade, — and it is supposed to keep sweet until the next morning. If the milk is properly handled there will be no trouble. It is wise for all farmers who make milk for contractors to carry out their wishes, and have the product come up to the contractor's standard; then, when the producer asks for a fair price of the contractor, the latter will freely give him his price, if the goods warrant; in other words, make an article that will be of such high quality and kept in such an attractive manner that it will be sought after.

I want to impress on the farmer that the vital time for milk is at the time it is drawn from the cow and the next thirty minutes after; everything depends on how it is handled at that time, — whether it will make a good product or a bad.

DISPOSING OF THE PRODUCT IN A CO-OPERATIVE WAY.

In setting before you the advantages of co-operation in buying and selling, I can do no better than to cite to you the origin, aim and achievements of the Springfield Co-operative Milk Association, of which I am treasurer and manager at the present time. The history of the association has now extended over a period of twenty years, and the balance sheet last issued shows the association in a sound financial condition; in fact, the growth has been rather remarkable, when the fact is taken into consideration that there was not an institution of the kind to copy after. Perhaps the successful growth is largely due to the loyalty of our farmers to our institution. The officers are stockholders, and men who produce milk; and the managers, with one exception, have been men owning stock and producing milk.

The purpose for which the co-operation was constituted was co-operative trade, to wit, supplying the city of Springfield and vicinity with pure and wholesome milk and dairy products.

The amount of capital stock when started was $16,000, later increased to $30,000. The par value of a share was $20, which share represented one producing cow. The number of shares was 800.

There is a code of by-laws, setting forth the manner of electing officers, and their duties, etc.

Division of Proceeds.

At the monthly meeting of directors they shall apportion to each stockholder his share of the net proceeds of the business, the amount of which shall be determined by the directors.

No person shall hold shares in the association to an amount exceeding $1,000, nor shall any stockholder be entitled to more than one vote on any subject.

No member of the association, and no stockholder, shall interfere with its business by selling milk either directly or indirectly, under a penalty of forfeiture of his stock.

I state here only a few of the by-laws, sufficient to show how rigid and strong they were drawn.

Advantages.

First, to secure a good market; second, to be reasonably sure of getting pay for their product.

The association does all its collecting, sending teams out into the country at a distance of thirteen miles, and taking out the clean cans, which have been washed at the association's plant, and which have been thoroughly sterilized with steam, — each can is put over a steam jet of 60 pounds pressure. The farmer has no cans to wash, no milk to transport, and all the milk he makes is taken, even a part of a can. You will see at once that this is a great help to him; no washing of cans, no transportation of the product, giving the farmer much valuable time to turn in other directions.

Size of Cans.

Each can will hold 10 quarts of milk, — no more. Is there any reason why you should give 10½ quarts or 11 quarts, and only get pay for 10 quarts? This was the system when the association was started, and is in force in some sections of our State to-day. In other words, a man keeping 20 cows keeps 2 of the cows to give the product away to the purchaser of milk in full cans. It would be as reasonable to give 65 pounds for a bushel of potatoes, instead of 60 pounds, established by law.

Growth.

In the year 1884 there were received at this association about 125,000 quarts per month, doing a business of $5,500 per month; now there are received about 350,000 to 400,000 quarts a month, and we do a business of $25,000 per month.

At the present time we have 250 farms producing milk and 150 farms producing cream.

We keep 40 horses, employ 35 hands, own and operate a large creamery in Washington County, New York State, and buy very large quantities of product on the outside.

Selling Milk.

We sell milk at wholesale and retail, supplying a large number of peddlers with milk. By drawing in these large loads of milk from the country (9 teams, drawing from 1,500 quarts to 2,000 quarts to a load) we minimize the expense per quart of collecting, and can sell to the middleman so that he had rather buy of us than collect his own milk.

About all the milk that is sold in Springfield is sold from the measure, — a very small amount is bottled; in fact we do not encourage customers to use bottled milk, as we think the breakage and loss of bottles is more than is saved in shrinkage and convenience in handling, and I am yet to be convinced that it is any more of a sanitary method than to sell direct from the cans. I will grant exception in one instance, — that, if the milk can be put into bottles immediately after being milked at the farm, then I think it is much safer to handle in bottles, from a sanitary point.

Delivery.

This point we are very particular about. We mean to have the horses, harnesses and wagons look attractive, — horses well kept, harnesses clean and wagons well washed inside and out. The men must be neat in appearance, always courteous, and must accommodate customers. All utensils used in delivery are sterilized.

Price.

Price to consumers at retail, 6 cents in summer and 7 in winter. We are able to pay our producers this year 3 cents per quart for their milk at their doors for the entire year. We furnish clean cans, and take all the milk they make. We do regulate the surplus to some extent. We notify the producers in November of each year that we will take one-third more milk in the months of April, May and June than the average of the milk they produced in the months of December, January and February preceding; all received in excess of one-third will be paid for at butter-fat prices. This has stimulated winter production, and has helped to adjust the supply. As the farmers are the sellers, they see at once the necessity of the rule.

The success of a co-operative movement like this is due to the hearty support which each farmer gives to his part of the work.

PRICE OF MILK.

The idea of one price for all milk—good, bad and indifferent—is wrong. The price of butter changes as to grade; the price of eggs, beef and other products changes as to the supply and demand; but the price of milk goes on forever at the same old price; shortage of market milk, caused by drought, high prices of grain,—in fact, no extraordinary condition can interfere with the price of this very important food. This is not as it should be. We frequently find that one quart of milk contains twice the food value of another, yet both are sold at the same price. The fact that an analysis of a number of samples of milk shows a wide difference in composition demonstrates at once that at a uniform price per quart there is an equally wide variation in the cost of its nutrients to the consumer. It will be seen, from a study of the average composition of milk, that as the total solids increase the percentage of fat is increased, in greater proportion than solids not fat. The consumer not only secures his total solids in the rich milk at a lower cost per pound, but he also obtains a product which is very much richer in material to supply the body with heat and energy.

These facts regarding the variation in the cost and quality of the food values contained therein clearly show that the standard in use at present as a basis of sale, viz., a quart of milk, is illogical and unfair to the producer, the distributer and the consumer alike. In the sale of milk the percentage of butter fat should be taken as the standard, rather than the quart.

The public are demanding better milk. They begin to see the advantages of high-grade milk, and when such is obtained people are willing to pay the extra cost of production.

INSPECTION OF MILK.

There should be some system of inspection of herds supplying cities with milk, not only as to the health of the animals, but of the cleanliness of the stables, the amount of air and sunlight they receive, and care of milk at the farm.

The farmers should commence to agitate this, not only to show that they are interested in the quality of the product they sell, but to gain friends among customers. It is of recent years only that milk supplies have come to be regarded as of importance to public health. The general public are rapidly becoming convinced that milk is of very doubtful purity many times. Here the producer can make a reputation for himself as always producing milk from a sanitary stand-point. We as farmers must take active steps to free the product from any suspicion.

There is a growing tendency among producers to improve the quality of milk by the introduction of Guernsey and Jersey cows. In the city I come from they have an inspector of milk; he not only takes samples of milk from carts and from stores, to ascertain the quality or amount of butter fat, but he goes into the country and inspects the dairies that produce milk for the city. If the stables and utensils used in handling milk are not in proper shape, clean and in order, the farmer is requested to get things in shape, so that on a second visit the inspector will find things all right; if not, the milk cannot be sold in the city. The inspector is doing good work, and we begin to see marked improvement in surroundings at the farms.

CONSUMERS HAVE AN INTEREST.

The consumers have a duty to perform, to provide clean and pure vessels, and have a suitable place to set away the milk where there is an abundance of pure air. Some people are most unreasonable in their complaints and demands upon the milkmen. These, and sharp competition between rival dealers, are two chief causes of dishonesty in the milk business. When a milk peddler knows that he is delivering the best of milk, and complaint is made that it is not yellow enough, or has not enough "body," and he is afraid of losing a good customer, he is tempted either to give that person a supply from near the top of a can, thus depriving some one else of cream which rightly belongs to him, or to do what he thinks his dishonest competitor is doing, — whatever that may be. There is a great desire on the part of the purchaser to get milk cheap. People too easily forget quality, and think only of quantity. Consumers should remember that, at the highest price usual anywhere, good milk is about as cheap an article of food as can be purchased. Buyers of milk should remember that milk can be contaminated as easily after delivery to the family as before; and the milkman is often blamed for bad milk, when it was made so by conditions over which he had no control, — sometimes left where dust and flies have access to it, or, if set in ill-ventilated refrigerators, or in cellars where there are bad odors, milk will be in bad condition in a few hours, no matter how good it was when delivered.

Consumers should demand certain things of the producer or middleman, and for these the producer or middleman should be responsible: namely, that milk should keep sweet at least twenty-four hours after being delivered to the consumer, if it has been held at a temperature of 50° or below; that milk should be clean; that the flavor of the milk should not be injured by improper feeding and handling; that milk should be of a certain known composition, which is uniform from day to day. These demands are not unreasonable, and they can be carried out with but little or no trouble by the producer and handlers.

Food Value of Milk.

It has always been known that pure milk is a valuable food. Next to bread and water, milk is more commonly used than any other article of food; it is used with few exceptions by every member of the family at every meal. All are interested that it be pure and wholesome. It is one of the cheapest foods, at the prevailing prices. Many persons use as little milk as possible, because the knowledge they have of careless ways in which some milk is produced makes it repugnant to them. No other food is more healthful and economical than milk when pure, and none is more dangerous to health when carelessly handled. If people were aware of the true food value of milk, they would use it more freely than they now do, to the advantage of both health and economy. Many people think milk a luxury.

It has been stated that a quart of 3 per cent milk, costing 5 cents, will furnish about the same amount of nutrition as three-fourths of a pound of meat, costing 9 cents. It is surely more economical to use less meat and more milk, as we find in milk all the elements needed to nourish the body.

The value of milk as a food is not as well understood as it should be, which undoubtedly accounts for the fact that, while ours is one of the great dairy countries of the world, we do not consume more than one-third the amount per capita that is used in some European countries.

The Standardizing of Milk.

I think the time is not far distant when this system will be generally used; it is the only fair way to market milk. This can be accomplished by adding skim milk or cream, as the case may be, to bring the milk to the required per cent of butter fat and solids. A 4 per cent milk is a good standard; at the prevailing prices over the State it is all the seller can afford, and it is as much as the purchaser should ask for. To illustrate the standardizing of milk as the only fair way to all parties interested, let me cite an instance which occurred in my city.

The analysis of two samples, taken from two dairies, A and B, as the milk was brought in from the country, showed the percentage of fat in one case to be 2.8 and in the other 4.6. As a basis for computation, let us assume that the standard quality as prescribed by law (3.7) is of value to the producer the price 3½ cents and to the consumer 7 cents per quart. A has been paid 25 per cent more and B 20 per cent less than the value of their products. In return for the investment of 70 cents (10-quart cans), and the labor and expense required to bring your purchase into the city, the middleman has in his possession, with intent to sell, exchange or deliver, two cans of milk, worth respectively 53 and 87 cents.

The middleman endeavors to comply with statute requirements; you mix the two. The fat will then test 3.7; yet, while the one rich in fat has brought this essential up to the standard, it has failed to do the same with the solids not fat, and the middleman with its distribution is liable to prosecution for the sale of milk not of good standard quality. Your customer receives in return for his money its equivalent in the production of heat and energy, but the percentage of food necessary for the formation of new tissue and the repair of the old is deficient. In this respect he would derive nearly as much benefit from a quart of whole milk and a quart of skim milk, costing 10 cents, as from two quarts of the mixed milk, at 14 cents. While in this case presented a wide variation is shown, it is by no means the extreme; samples have been taken which tested 2.4 and 5.6 respectively.

You may say that, while the facts are as shown in the case of the two cans, the same were not obtained in large quantities.

On two occasions samples have been taken from 50 dairies, large and small. The average percentages were: fat, 3.9; total solids, 12.61; solids not fat, 8.71.

Samples of mixed milk, 3,000 quarts, showed: fat, 4; solids, 12.54; solids not fat, 8.74.

Out of 341 samples of milk analyzed, 42, or 16 per cent, were found to be not of good standard quality.

Of 163 samples analyzed, 59, or 36 per cent, have failed to meet the required standard (3.7).

The only disadvantage I can see is in a large business, where there are several thousand quarts sold; it would be necessary to mix all the milk, and the customers would not get milk from the same dairy every day, as now. But if the large firms handling several thousand quarts a day pasteurized their milk, and standardized it, there would be no necessity of keeping each dairy separate; all would be served with the same quality of milk.

The only apparatus necessary to standardize milk is a cream separator and a Babcock milk tester. Call the standard 4 per cent milk; if the dealer is putting out 4.5 per cent milk, he is losing one-half of 1 per cent; and on a large amount of milk, say 4,000 quarts, he is losing many dollars a day, and in the year thousands.

IMPORTANT POINTS FOR THE FARMER.

Every farmer should be made to realize the importance of caring for the milk; that there is no other food that will absorb bad odors so quickly as will milk, or deteriorate more rapidly under adverse conditions.

No other food is produced under conditions where it is so difficult to prevent contamination. I have asked my dairymen to use more sanitary methods in handling their milk, and it has resulted in failure. Their reason is, they say, that milk cannot be produced under sanitary conditions for the prevailing prices. Nevertheless, if the dairymen would produce milk under sanitary conditions, and so advertise and ask the public to inspect their methods, their product would not go begging; the consumer would be willing to pay advanced prices.

If the farmer would conduct dairies where milk is produced and handled in as clean and wholesome a manner as milk can be made; have his cows in good condition, free from disease; use nothing but wholesome feeds; have the stable well lighted and ventilated, often thoroughly cleaned; cows kept clean and comfortable; the attendants healthy and clean; the utensils sterilized daily; the milk promptly cooled after milking to 45°, — it would not be long before his produce would be sought after, and he would find no difficulty in disposing of it at advanced prices.

The shortest distance between two points is a straight line. Let the dairyman get down to business at once.

GROWING DEMAND FOR CREAM.

The sale of cream to be used on the table has greatly increased in the past few years, and is increasing at a rate of about 25 per cent over the preceding year. This has been my experience with the market.

The cream sold to-day is no longer the thin skimmings of milk set but a few hours, formerly sold as a great favor to the customers in the cities, to whom the name suggested a perfect delicacy, and who were happy with it in the absence of anything better (such cream would be considered nothing better than good 5 per cent milk now), — but a thick and sweet article, which is much cheaper than the old one, compared at their respective prices. During the fruit season a very large demand is made for it and the prices obtained are so much in advance of the possibilities of buttermaking during the same part of the year as to justify the cultivation of the trade which calls for a 40 per cent butter-fat cream. The best cream is obtained by the separation from the fresh milk, and then the proper management of the cream. It should be cooled to as low a temperature as possible within a short time after it is separated; 35° is none too cold, 32° is better. The cream trade when at its best fortunately comes at a season of the year when milk is plentiful, and helps to work off the surplus milk to advantage.

With this growing demand for cream, the producer will see at once the importance of making a milk of a high percentage butter fat; but with this growing demand there is a great temptation for some unscrupulous dealers to lengthen their supply by using coloring matter and some of the thickeners that are on the market, palming off an inferior article, containing a small amount of butter fat and appearing to contain a little more than standard amount of fat.

An illustration that came under my own observation this season will make this clear. In my city of Springfield there is a dealer who had a very large cream trade, — in fact, this was his particular business. I noticed that his trade was increasing, and a number of my customers were leaving, and buying his cream. I bought some of his cream, and I found that it appeared very heavy, but did not show up the percentage of butter fat that it appeared to contain. I thought there was a secret in handling which I did not understand. I was then putting out a 40 per cent cream; I increased my percentage of fat to 45 per cent, and even then my cream appeared thin beside his. It was not long after that our inspector of milk took samples from all dealers in the city. The result was that this dealer I have been speaking of was summoned into court, and paid a fine of $100 for use of foreign substances in this cream. It was found he had been selling two grades of cream; one was supposed to contain 30 per cent of butter fat, which on analysis only contained 24 per cent, but had the appearance of having 45 per cent butter fat in it; the other was sold for a 40 per cent cream, — which was the grade of cream I was putting out, and the grade most used for family trade, — but contained only 34 per cent butter fat, but to the eye would pass for 50 per cent.

This is the kind of competition we were up against, — we putting out cream actually containing 11 per cent more butter fat than our opponent, and yet not giving satisfaction. This is a case where the city inspector was a very valuable officer. After the papers had commented on the findings of the inspector, one of my customers called us up by telephone and complained that the cream was not pure, — it was too thick to be pure cream. She was raised and spent some of her younger days on a farm, and knew what cream was; and she thought they had got to a bad pass if the people of Springfield could not get pure cream. I tried to explain it was all right, — perfectly pure; but of no avail. She would take the sample to the inspector, which she did. The inspector tried it, and found it to contain 50 per cent butter fat; and reported to the customer that the association must have made a mistake somewhere, and put out a 50 per cent instead of a 40 per cent cream. The fact was, my man let his separator get away from him, and all customers had a treat for once.

There is no mistake that the appearance of the goods to the customer's eye is what tells.

CONCLUSION.

I am glad to see the farmers organizing, and getting into shape to do business on business principles. The Boston Co-operative Milk Producers Company is a good example of organization. In union there is strength; and it needs loyalty on the part of all members to stand firm by its by-laws, and follow their leaders. And if at the head of the organization there are elected men of good judgment and tact to shape the policy and map out the line of campaign, it will succeed in its object; if the right kind of men are at the head, it will be a pleasure for the contractors to meet them and adjust their differences.

Farmers must remember that the methods of producing milk years ago can no longer be used. No branch of the dairy industry has received more attention in recent years, or made more substantial progress, than that of producing milk for delivery to consumers or shipment to market. The demand for improvement in the milk supply has led to much better practices on the part of many connected with the business. Producers must give more time and care to selection of cows, their health, food and water; to the matter of cleanliness in milking and care of milk while on the farm. Many points brought out in this paper are applicable to all producers of milk, regardless of size of dairy or location; and in other points local conditions will have to be considered.

Every year should mark improvements in every dairy farmer's methods. He should raise his standard a little higher than the year previous, and press on and up, raising his profession to that second to none, and turning out a product that can be labelled "strictly pure, produced under strict sanitary regulations, guaranteed to contain the amount of butter fat and solids required by law."

The CHAIR. You have listened to a very comprehensive and valuable paper; and our practice has been, as notice is given in the programme, to follow the lectures by discussion, in which all persons present are invited to engage. The matter is in your hands.

Mr. GEO. M. WHITAKER (of Boston). I desire to compliment the speaker on his paper, — it is a perfect encyclopædia of information; and I desire especially to compliment him upon the emphasis which he has placed upon the importance of the farmers taking an interest and an initiative in the matter of herd inspection and more care in the production of milk. It has been a part of my duty in the last few months to make somewhat of a careful inspection of the milk supply of several of the larger cities in the east, and I am absolutely amazed at the great attention that is now being given to the milk question by the officers and medical authorities in the cities. I think the farmers are not aware of what might be called almost a revolution that is going on at the city end of the line. The paper of the speaker is valuable as a connecting link in opening up the means for the farmer getting in touch with the city end of the business.

The advance movement has gone so far that the large contracting firms of Boston have bacteriologists regularly connected with their establishments, in addition to their chemists, to test the milk for bacteria every day. The Boston board of health has established a bacteriological standard; and milk with a certain amount of bacteria is liable to get the producer into trouble, just as much as if the milk was deficient in solids.

In New York City I found that the city board of health pays more attention to the milk question than any other one topic. There are pages after pages devoted to it in their reports, and photograph after photograph given in illustration of what they say. In New York they have established a temperature standard, instead of a bacteriological standard, because they say the bacteria multiply very rapidly with a higher temperature; and consequently it is not of so much account whether the milk has more or less bacteria at the start, if it is only kept cool. There the inspectors put their thermometers in the milk, and if it is over 50° they pour the milk out in the gutter.

In Philadelphia the board of health is taking samples of milk every day, and testing them, rather than sending a veterinarian into the country to test the animals. The day before I was there they had taken 70 samples, and out of the 70 they found pus in 4. This is not a very pleasant word to use in connection with food, but it illustrates what a big movement is going on under the direction of the health organizations in the city.

As the speaker has said, the farmers want to know of this, and want to be at the very front themselves in assisting in the inspection of herds and the proper care of milk.

The CHAIR. I see Mr. Ellis of West Newton in the audience. He has had considerable experience in this line, and we would like to hear a few words from him, either in criticism or suggestion.

Mr. GEO. H. ELLIS. I did not come to speak, but to listen; and certainly we have had a most valuable paper. I don't know that I can add anything to it. There are some points that need to be touched in other ways, and I for one don't see just how they are to be touched. As the speaker stated, and as Mr. Whitaker has said, the standard is being steadily raised in the cities and towns for the consumer; but in most cities, — for instance, in Boston, — while the standard is being raised, while they are adopting new plans all the time in the inspection of milk, yet the price to the consumer is not increased. There is no mistake about our needing all these sanitary precautions at the farm; there is no mistake, either, that the consumer has got to pay for these precautions. In some way or another the consuming public in our large cities has got to be educated up to the idea, before the farmer can do very much.

The speaker stated that, if the farmer himself will take hold of the matter in the right way and will work on sanitary lines, he will find an increasing demand for his milk. Is that true with reference to sections which supply milk to the contractors for the city of Boston? It isn't the fault of the contractor, it is the fault of the consumer. The contractor cannot pay an extra price for this extra care and sanitation; yet it costs the farmer. Milk cannot be properly made and properly handled at the price the farmer gets from the contractor. Again, I want it understood that I am not for a moment blaming the contractor. I don't believe the milk contractors in the city of Boston are making a large amount of money, I believe they are paying as high a price as they can afford; but the consuming public must be educated up to paying a fair price for the food value contained in the milk, for to-day they don't do it. It is perfectly well known, as stated by the speaker, that milk is to-day one of the, if not the, lowest-priced food on the market; and there is no reason why a fair price should not be paid for it.

We want the farmer to adopt these sanitary methods; we are anxious to see it done; but I don't myself see just how it is to be done. I don't believe there is any profit in it, when he does it; yet I do thoroughly believe that, in order to get the consumer to pay on his end, the producer has got to keep his end up; and there is no question but what it is being done to an extent that it never has before, and yet the retail price of milk in Boston is not increased. I don't refer, of course, to the "slop shops," so called, where milk has been sold for 3 and 4 cents a quart, and where unsanitary conditions have existed to a certain degree; I refer to the hard-working farmer throughout the State, who does his best to deliver his milk to the contractor in perfect condition. The city end has got to be educated; and I am inclined to think that the State Board of Agriculture cannot do a better service to the farmer than in trying to convince the city-bred man and woman of the value of this food.

One other point in the earlier part of the address has impressed itself upon my mind, and that is, in reference to the soiling system, — the providing of green food to the cattle throughout the season. With the peculiarities of this climate, I don't believe that any man living can provide such food throughout the season. He can have his green food coming regularly, to be sure; and his regular supply has got to be taken care of, if he is to adopt the soiling system. But what of the bad season? There is only one way he can adopt this system, and that is by putting enough ensilage in his silos to carry him through the season. But what of a very wet or a very dry season, when the crops which he has planned to follow each other do not follow each other as they should? I say the peculiarities of this climate make the soiling system an impossibility.

Mr. A. M. Lyman (of Montague). I am glad to emphasize what Mr. Ellis has said in regard to this education among the farmers and the producers of milk, which seems so necessary. There has been a thought in my mind for a long time, that the State Board, through the Dairy Bureau, might have more of an educational feature to it than it has to-day, which would be beneficial to the farmers.

It costs no more to make a good product than it does a poor one; and if we encourage this feeling among the farmers, their product will be so much improved. It is simply a waste on the farmer's part if he does not keep his product in the best possible shape until it reaches the creamery or the consumer. It has been stated, on the best authority, that there is no product which makes so perfect a food as milk when it is first made; there is nothing to make it better, — we have only to keep it as it is.

Hon. M. A. Morse (of Belchertown). I read one day that so many bacteria are necessary in every quart of milk; and the next day I read that there shouldn't be 500,000 — or whatever it is — in it. I don't know whether any authorities have ever designated just the exact number necessary, or not, but I do know this: if the health authorities want to get at the root of the matter, they will get at these cans that come to you and to me, which are so extremely dirty. Now what is the use of talking about your barn and my barn, your filth and my filth, when you and I haven't seen anything about our premises for years so filthy as those distressing milk cans that are sent to us from Boston? Why don't the health authorities strike at the root of the matter, and not come onto us poor, innocent, hard-working fellows? We always get the hard end of everything, and there doesn't seem to be anybody to stand up for us. Let us force this thing; let us demand that the utensils which come to us shall be fit to receive the milk which is produced on our farms; let us have clean utensils first.

Mr. Allen. As Mr. Morse has brought up the shipping back into the country of those filthy cans I want to say that last winter I made several visits to the contractors in Boston, and I couldn't quite understand how the State Board of Health, or the local boards of health, could permit of the transportation of such filthy cans. That, you will notice in my lecture, was one of the chief points in our co-operative movement, — that we have our cans brought to our farms clean, sterilized. How is it possible for the average farmer throughout Massachusetts to sterilize those cans? How can you expect him to sterilize them? These are questions we would like to have answered.

The Chair. Do I understand the lecturer that he would aerate the milk as it comes from the cow?

Mr. Allen. My point is this: that, if you can aerate this milk immediately after it is drawn from the cow, in a room where the air is pure, you not only take out a certain amount of odors that are in the milk, — if you have been feeding turnips, or cabbage, or any food that carries odor in it, — but you also take out the animal heat, and bring the milk down to a low temperature instantaneously. We have five milkers at our place. We run all our milk over a rotator, winter and summer; and I have noticed, since I commenced to aerate it, which was about four years ago, that my milk has a more delightful taste to it, so much so, that by taking two samples of milk, one that has been aerated and one that has not, I could pick out the aerated milk at once by the taste. It tastes cleaner and purer, and helps the product in many points, especially in preserving the quality of the milk. We should take more pains with our milk, in making and protecting the product, and then demand the price.

The Chair. I see Mr. E. A. Waters in the audience. He has been superintendent of the Moen farm in Worcester, where they make extra fine milk.

Mr. Waters. I want to emphasize what Mr. Ellis has said about the consumer helping the farmer out by paying him a fair price for what he produces. I contend that there is no farmer living in New England who can make milk and sell it at 3 cents a quart at his door, and get any profit out of it. I think, if I were going into the milk business on my own hook, that I shouldn't pay a great deal of attention to sanitary conditions, if I were away back in the country, and had to take cans such as are given to the farmers who furnish the Boston market with milk. A farmer who lives near a large town or city, and retails his own milk, can in a measure get some returns for good, wholesome milk.

If he can get his customers to go out and see the way he makes the milk, and the way he takes care of it, he can get a good, fair price for it; but even then he can't get enough to make any money at it. He ought to get from 10 to 12 cents a quart for his milk, providing he is furnishing good, wholesome milk, 5 per cent or more.

The lecturer spoke about his customers finding fault with the cream because it was too thick. I know that there are some people who, if you furnish them with 50 per cent cream, will complain of it because it is too thick. I had a customer last winter who found fault with the cream, saying it was too thick, she couldn't do anything with it, and wanting to know what the trouble was with it. I told her how I thought she could thin it, which she did, and found it was all right. I had another customer telephone me that the milk was growing poor, and I asked him how much cream he got from the top of the bottle. He measured it, and said three inches and three-quarters, and I told him I didn't make anything any better than that, and said, "I can't furnish you cream for 7 cents a quart." I haven't heard anything further from him.

Mr. VAN NORMAN (of West Newton). I understood Mr. Lyman to say that it was as easy to produce a good quality as it was a poor quality of milk. Isn't there more profit on a cow that produces 60 or 80 pounds of 2.6 per cent milk that is sold for the same price, than on a Jersey that produces 25 pounds of 5 per cent milk? If the value is in the quality, how is it possible to produce a good quality of milk as easily as a poor one?

Mr. LYMAN. I intended to say that the same milk can be produced in a clean and nice condition as cheaply as though it were not clean and nice. But I will say, what most of you know, that milk cannot be increased in its butter fat, whatever be the feed given to the stock, whether it be a richer grain or poorer. Every milk will analyze the same percentage of butter fat, whether the stock is ill fed or well fed.

Mr. VAN NORMAN. I think that, perhaps, would bear qualification. Can a man milk as many cows when brushing the udder and taking care of them nicely, keeping them clean, as he can if he doesn't do this? I think it is impossible. I want to take exception to another remark. I think that it is impossible for the farmer to create the price of milk by improving his methods. He simply can't do it, if he is going to live. The average farmer, who is dependent for his living on what he gets from his milk, can't afford to do it. He has got to meet the market in the cheapest possible way that he can, especially at the present time, when milk does not command a price which makes a living possible. The point is well taken by Mr. Ellis, that you have got to educate the community to the difference between a good and a poor quality of milk; for as long as a good quality gets no better price from the consuming public than a poor quality, there is no inducement whatever for the farmer to produce a better quality at a greater cost.

Mr. ELMER D. HOWE (of Marlborough). One other dealer and myself handle about one-third of the quantity sold in our city; and we undertook to educate the people up to the idea that milk cared for and handled properly was worth more — especially with the increase in the cost of producing it, which was maintained during the last year — in the winter than it was in the summer. We undertook to raise the price to 7 cents a quart during the winter, with the result that so many of our customers went to the other dealers that both of us had to go back to the price the other dealers maintained. They either change dealers, or say, "We will pay the additional price, but we won't use so much milk;" and the consequence is, the attempt to educate people up to the idea of a higher standard of milk takes all the profit, in the way of advertising and educational methods, which you get from the increase in the price of milk. I think the people are not yet educated up to the point of being willing to pay for the extra labor involved. Therefore, we simply must meet the market as it is, making an article that will stand the test of law, and will also meet fairly well the demands of the people. I have talked with Mr. Ellis, and he tells me that he gets 10 cents a quart, where I get 6, but when you come to figure out the net profits there isn't so much of a difference after all, because he has to expend a large part of that extra price in maintaining the quality of his product and in educating the people up to the idea of its extra quality. In the section where I live it would be almost foolhardy to undertake to educate the people up to the idea of a higher quality of milk and paying an extra price for it, because there would be so little demand for it that there would be no money in the business. In most sections of our country we have got to meet the market as we find it.

Just a word about the inspection of cattle, as conducted over the State of Massachusetts at the present time. I am in favor of having cattle inspected, but I would have it done by persons qualified to do the work properly, and not by those appointed for the payment of political debts. Milk inspectors who simply sit in their offices and expect us to come and pay them 50 cents every 1st of May are of little service. If we are to have these officials, they should do something, so that dairymen who are willing to comply with the conditions should receive recognition from the public. Here is a line of work in which dairymen who are alive are only too anxious to co-operate with the advanced ideas of the public. If there are others who are not willing to comply with these conditions, let them simply sit down in the background, and not be permitted to compete with those who are willing to do it.

QUESTION. Are you in favor of using ensilage?

Mr. ALLEN. I am in favor of ensilage when fed judiciously, and think there is no harm whatever in it. It won't interfere with a gilt-edged product, only you want to feed it judiciously.

If you will allow me, now that I am up, I would like to reply to Mr. Howe, who spoke a few moments ago about doing about one-third of the milk business in his town. I would suggest that he get the dealers all together, and form what we have in the city of Springfield, — a milk dealers' protective association, which has been in existence for a number of years, and works beautifully. We demand fair prices, and we protect each other, and in such a way that we have no difficulty now, when the fall comes, in advancing our price to 7 cents for retail milk. It is so logical that almost any pedler can see at a glance, if you sit down and talk with him, that it is working to his advantage. If he can get 1 cent a quart more for 200 quarts which he puts out, that makes $2 a day, and it is a nice little profit to him. It is not hard to get the consumers to pay it. They are willing to do so in Springfield. Now the price is not shifted; it is simply a matter of fact that the winter price is 7 cents and the summer 6. We all work in harmony, and we have the milk business in the city of Springfield on a paying basis, so that the middleman will get a fair livelihood from it. He can pay his bills and save up something on this basis, while prior to this he was getting as many prices on the street as there were houses. Some milk was sold for less than it could be produced for, and the result was, the farmer had to stand the loss in the end.

Mr. Howe. That is just the material we have been trying to work with, and it worked like this: they wouldn't all come together to make the agreement; there would be perhaps four or five, perhaps three or four, who would stay out, and those three or four would not only refuse to raise the price, but would sell for 5 cents, even right in the winter, when there was no possibility of making a profit. Oftentimes a young man will start in and run his creditors as long as he can, and then in about six months he meets the farmers he has purchased milk from, and all of his other creditors, with about 5 cents on a dollar.

Mr. Waters. I think it is much easier to form an association in Springfield than it is in Marlborough or Worcester. In Worcester the producers have tried to form an association, to raise the price of milk; and the pedlers have tried to raise the price of milk among themselves, and they couldn't agree. The whole trouble comes in this way. We have a certain class of farmers in and around Worcester who peddle their own milk; they are good farmers, but you can't get them to raise the price of milk, or to come to any agreement whatever with the rest. They are called producers, and also pedlers. If they would come in with the farmers who want to raise the price of milk, it could be done; but they won't do it. The same condition is found in Millbury that exists in Worcester. Now I claim, as Mr. Howe says, there are men in the milk business who go out among the farmers and buy their milk. The farmers wouldn't go to the bank and lend these men $500, or $50, or $25, but they will sell them $300 or $400 worth of milk, without any security. Then the pedlers skip out, and that is the way it goes.

Mr. N. I. **Bowditch** (of Framingham). I now sell direct to large consumers in Boston institutions. I was in the retail business here in town for a year or two, and we formed a milk dealers' association just before I sold out. We put the price up, and the milk dealers in Framingham, I think, were more conscientious than in those towns to the westward, because they all stayed by their agreement. One man lost over 50 per cent of his customers, because they couldn't afford to pay the higher price.

I am very much in favor of what Mr. Allen said about the protection of milk, and I try to produce a high quality of milk by the best methods, as it goes to hospitals in Boston. I find that all milk costs me, when it leaves my place, over 4 cents, and it is put up in large cans, so that I don't have the expense of small cans for retail, or glass. I think he says that his association pays 3 cents; and I am unable to see how the farmer can produce a high quality of milk, clean, and under the best sanitary conditions, and get a new dollar for an old one.

Mr. **Allen**. Mr. Bowditch probably noted in my lecture that we send back 13 miles from the market. A great deal of this milk is produced on land that is not high-priced land, and where the product is not worth as much as it would be nearer the market. But understand, — and I want to emphasize this, — I honestly think that the Springfield Co-operative Milk Association is paying the "banner price" for milk in the State of Massachusetts to-day. Take the transportation of the milk; think of all these thousands of farmers who get up early every morning and draw their milk to the railroad station, 1 mile, 5 miles, 10 miles, 12 miles; think of all the wear and friction of their utensils; take into consideration the fact that we take every quart of milk a man makes; then we abolish any washing of cans; the teams drive up to a man's house and set off 10 clean cans on the walk, he puts his 10 full cans on the wagon, and that is all we ask of him; he has all that extra time to attend to his other duties, and I tell you, gentlemen, that is a good deal. Take it year in and year out, if you charged that time up, you would find you had put in dollars and dollars that you had received no return for. I don't want you to understand that there isn't milk sold for more money, but, considering all these things, our farmers get a fancy price, — the banner price in the State.

Mr. C. E. **Parker** (of Holden). The people who produce milk for the lecturer's association get the munificent price of 3 cents a quart, 25½ cents a can. Is that larger than the people throughout the State get, even from the Boston contractors? It seems to me that they pay a larger price than that. The lecturer spoke of selling milk in three different ways, either through the contractors, peddling it himself, or to the middlemen. I wish we could contrive some way that the middlemen could be eliminated from the business. I have heard of one man who circulated around Shrewsbury and cheated the farmers out of a good many hundred dollars. If there is any way to get the better of such characters, I wish we could find it out.

The **Chair**. Part of the pay that the farmer gets from the Springfield Co-operative Milk Association for his milk is the surety that he will get his pay; that is worth a good deal to him. He is sure at the end of the month of getting his check, and 3 cents a quart is a good deal better than 3½ with a risk of losing the full amount. We must now bring this session to a close.

Adjourned.

Afternoon Session.

The afternoon session opened at 2 o'clock, Mr. N. I. Bowditch of Framingham presiding.

The **Chair**. Before beginning the regular work of the afternoon I wish to read a circular issued by the Massachusetts Society for Promoting Agriculture, which I have the honor to represent on this Board. This circular relates to the offering of prizes aggregating $1,000 for the four best-managed farms in the State, owned and worked by farmers as their only business and means of support. I hope that any one interested in this matter will come to me later for copies of this circular, that the information may be spread as widely as possible throughout the State.

[Circular to the farmers of Massachusetts read.]

The lecture for the afternoon is "The profitable dairy cow," by Prof. Charles S. Plumb, a graduate of the Massachusetts Agricultural College, and now professor of animal husbandry in the Ohio State University. It gives me the greatest pleasure to present to you Professor Plumb.

Professor **Plumb**. I can assure you that it was with considerable pleasure that I received an invitation to appear before this State Board of Agriculture. I left Massachusetts over twenty-two years ago, and it has never been my pleasure to come before a gathering of your farmers, and consequently I anticipated the privilege of making your acquaintance. I was born, raised and educated in this State. I own some land here that I take a great deal of interest in, and my sympathies have always been in close touch with Massachusetts, so much so that I have often felt that the time might arrive when I might spend the rest of my days in this State.

In presenting the subject to you to-day which I do, I shall perhaps treat it in rather an unusual fashion, not as addresses are ordinarily delivered before agricultural organizations; and I trust that my manner of presentation will not in any way affect your interest in bringing out the discussion following my remarks.

THE PROFITABLE DAIRY COW.

BY PROF. C. S. PLUMB, COLUMBUS, O.

Some years ago a young man named John Winslow graduated at an agricultural college. He was born and reared on a New England hill farm. There his father won a living for the family, in the main from the keep of a herd of cows, the milk of which was sold to a near-by creamery. It was slow work, for the profits were not large, but they made a living.

The young man had a love for the country and the farm home. He had received a district school education, and gradually the idea had crystallized in his mind that he needed more education. His attention was directed to the agricultural college. An investigation convinced him that this was the type of institution that would enable him to become a broader, brainier and more capable farmer. Ambition, health, work, brought him through college. The four years passed by rapidly, and once again he was back on the farm.

But this was a different young man returning to the farm from the callow youth who had gone out from Rockdale four years before. His intellectual forces had strengthened, and his capacity of grasping and solving problems had rapidly grown. His father soon realized that the young man of twenty-two was no longer a boy; he was a man whose judgment he could rely upon.

On various occasions during his college life, when visiting home, John had looked over the herd, and the thought gradually grew upon his mind that the cattle in the stables were not what they should be. In his junior year he had taken a course of instruction which involved a term of work studying breeds of live stock; another term was partly devoted to the principles of breeding; and the subject of feeds and feeding occupied several hours a week the third term. All through this year of study he had been given practical work in judging live stock. His father owned a dairy herd, and the instruction in animal husbandry in the college had been teaching him important lessons, which, in his opinion, had a direct application to the conditions at home.

What were some of the real practical truths that he had been taught, leading up to success? He had learned, by repeated illustrations, that like produces like, — that this is a law of breeding that is a part of the creed of every great breeder; that poor animals mated produce poor animals; that sires from superior ancestry produce superior offspring; that no great breeder has ever risen to heights of eminence, and built up a great herd, excepting by weeding out the inferior and breeding to the superior; that pedigree is worth nothing, unless backed by constitution and individual merit; that no man can be regarded as an intelligent breeder who does not breed on the basis of a knowledge of some of these things.

The laboratory or practical work in judging in those college days commended itself to John in no uncertain manner. There was a large room in one corner of the cattle barn; tan bark covered the floor. Here the instructor brought his class of young men. A cow was brought in. The students were instructed in the various points which go to make up the animal form, and their relative importance to each other; they were told what the ideal, mature cow of this kind should resemble. Then they were requested to take blank score cards and judge and score the cow before them, and see how she would compare with the ideal described. That was not easy the first day, but more practice smoothed the way. Finally, several cows were brought into the room and were ranged up side by side, and the class was directed to judge and place them in their relative order of merit. That was just what the judge did at the county fair, only he was obliged to give a written explanation, on a specially prepared sheet of paper, as to why he placed those cows in the positions he did. Then finally the instructor placed them as he thought they should be, which was followed by a discussion of the placings of both students and teacher. That sort of thing was interesting, and John saw a connecting link here between this college work and the home herd.

There was a more important phase to this study of stock. As the lessons continued, it was pointed out that there were different types of cattle that had gradually developed into high degrees of perfection, each in its class. This was beautifully illustrated on one occasion when this subject was first discussed. Three cows were led into the room, each quite distinct in type. One was spare of flesh, in fact, her ribs showed somewhat; but she had a big body; rather short, clean-cut, handsome legs; a thin, fairly long neck; and a gracefully turned, rather short head. Back between her thin, muscular thighs, below a broad level rump, was suspended an immense udder, shaped like a half moon; while extending along the belly away from the udder were two big milk veins, twisted like snakes, remarkable in their development. The instructor told the class that such an udder should extend well forward along under the belly and up high behind the thighs, be level below, and thick; with four medium-sized teats at each corner of the udder; and when milked out it should shrink up and feel mellow and pliable in the hand. This was a cow of the true dairy type,—just a grade, but she was rarely beautiful, John thought. And when she was milked out before the class, all that striking fullness disappeared, and a shrivelled, wrinkled udder, one-half the original size, was in its place. He had never seen such a cow as that at Rockdale. Alongside of her stood a broad-backed, deep-bodied cow, full and thick in bosom and hind quarter, short of leg and strong of neck. She was smooth and rather fleshy, and her udder was not important; but she would cut some great steaks. Then he was taught that this was a cow of the beef type, given to converting her food into meat, as the dairy cow did hers into milk. Then there was a third cow, neither lean nor fat, sort of halfway between the other two, with a fairly large udder, that they were informed was a "dual purpose cow." As this young man from that mountain farm compared these cows, and as he later on came to be more and more acquainted with the details of difference, he began to feel that the herd at home was far, far from its profitable possibilities.

There were other lessons taught at this agricultural college that bore much on future problems to be solved. The college instructor in dairying required the students to test the cows of the college herd occasionally. They were obliged to take samples of the milk of each cow of the herd at each milking for a number of days in succession, and find out how much fat there was in the milk, so as to compare values. Here John learned that two cows might be giving exactly the same amount of milk, though that of one contained twice as much butter fat as the other. As creameries paid for milk on the basis of its butter fat content, he soon saw that quality as well as quantity was an important consideration with milk production. Thus, as he attended his daily duties about the college, he came to see that success on that dairy farm was dependent on several things, each important in itself.

These were some of the things taught this young man during the four years prior to his home coming, and their value was never underestimated by him. Not long after his return his father gave him a half interest in the farm, and he settled down in a partnership full of anticipation of the future.

There were in the herd at Rockdale 16 native cows. They were just common, plain, every-day scrubs. John's father fancied some of them mightily, but he was not justified by facts in this admiration. One day the junior member of the firm came home with a spring balance. He proposed to begin weighing the daily milk yield of each cow. He knew it would not take much extra time, and they would learn something of what the cows were doing. The senior member smiled, but thought it a harmless pastime.

John said: "Father, we don't know enough about what our cows are doing. Do you know that records show that the average dairy cow in this State produces only 150 pounds of butter a year? There have been some mighty interesting investigations made by some of our experiment stations, which prove that we dairymen have some truths to learn that we should have learned long ago. Now, for example, the Illinois Experiment Station years ago published a bulletin giving records of individual cows in 8 farms in that State. What did the bulletin show? It showed that there were 144 cows in these 8 herds for a year's test. One herd made a net loss of $4.54 on each cow, some made a small profit, and one got good results. Just think, 6 of these 8 herds had cows that did not pay for the food they consumed! They found all sorts of records among these cows; but the one that had the best showing gave 8,949 pounds of milk, and made 472 pounds of butter; while the poorest cow produced only 1,482 pounds of milk, which yielded but 68 pounds of butter. The average production of butter of 7 of the herds was only 202 pounds a year; and I don't see how there is any money of importance in it for us if we can't beat that sort of record, so I propose to find out what our cows are doing."

It wasn't long before the whole family had begun to study the daily milk record. The days crept by, and the milk record grew more and more interesting. Finally, John proposed buying a Babcock fat-testing machine, and testing the individual milk of the cows for butter content. They had tested the herd milk at the creamery, but this was not enough. This innovation came in more easily. The fascinating and suggestive work of the scales was emphasized by the Babcock. The months rolled by, and all the time John was investigating and thinking. Bill Brown, their nearest neighbor, didn't take any stock in such foolishness, and he knew the Winslow family would land in the poorhouse yet. He was just waiting for that joyful day, when he might say, "I told you so."

You remember that John learned something of dairy and beef type when in college. After he graduated, Professor Hæcker of the Minnesota Experiment Station wrote a bulletin which contained a record of his researches on dairy cattle, in which he showed that cows of the dairy type had a special value over the other sort. This bulletin lay on the dining room table, and the old gentleman picked it up and began to glance over its contents. There were some pictures in it, and these caught his eye. They represented cows of different types. Then he began to look over the contents of the bulletin. Finally he said: "John, just look here. You know you have talked to me about this form business with cows, but it never struck me as amounting to much; but this man Hæcker seems to have a pretty good bit of evidence here that there is some meat in the cocoanut. He has been feeding some cows out there at that Minnesota station, and he kept a record of every bit of food they ate, and of all the milk each cow made, and of the butter in her milk. My, but that was a big job, though. Now he has divided up his herd into those with dairy type and those of general purpose type, and this is what he shows they have done. He had 20 yearly records for each class. The dairy type cows produced an average of 7,876 pounds of milk and 430 pounds of butter; the general purpose type produced an average of 6,035 pounds of milk and 295 pounds of butter. In this book here, he says that, by valuing the skim milk at 15 cents per hundred, and allowing one-eighth of the milk for cream, there is an excess of $2.42 in favor of the dairy type cow for skim milk; and allowing 16 cents for butter, the 135 pounds gain of the butter of this type gives a further gain of $21.65. Adding this to the $2.42 gives a total of $24.07 in favor of dairy over general purpose type. He also found that the fatter the cows were, or the less belly they had, the less money there was in them. Guess we'd better look into that, John."

As the months rolled by, it became clear to father and son that radical changes must be made in that herd. The cows showed an average for the herd at the end of the first year of only 180 pounds of butter fat each, which, at 25 cents a pound, yielded a gross return of $45. The feed and cost of keep ran up to $40 each, so where was the profit? And the scales and Babcock showed that some of the cows were boarding at the expense of the Winslow family. It was interesting, for the fact is, these robber cows lacked dairy type. John discussed them with his father. There were 6 of them, and he showed them up in their true light. Point-ing to one of them — she had made only 2,000 pounds of 5 per cent milk that year — he said: "Look at her beefy thighs, and smooth, meaty back. She hasn't any room between her thighs there for an udder anyway. The sooner we get rid of her, the better off we'll be. Then take old Speckle. She never did have any belly, and her bag is all cut up in front, so her fore teats are three inches above the others; she isn't a good feeder, and a poor feeder never made a good breeder or milker. Let's cut down the whole herd by throwing out these 6; it's money in our pockets." Old man Winslow saw the wisdom of this proposition. He couldn't think of any argument quite equal to the facts produced by scale and Babcock test. Furthermore, the arguments on cow shape which John and Hæcker presented were invincible. So the cows were sold.

You have heard the saying that "blood will tell," and that "every man has a right to be well born." Scientific men apply this to the beasts of the fields, as well as to the man who directs their destinies. The Winslow family had little surplus money; it was representative of many a hill family in worldly goods; things must be accomplished gradually. But Mr. John Winslow had not forgotten his lessons of other days. He had studied pedigrees as a student; he had learned of famous cows and great sires. Had not thousands of pure-bred dairy cows records of 14 or more pounds of butter fat in seven days? Had not the descendants of Golden Lad, King of St. Lambert, Paul DeKol, Sarcastic Lad, American Champion and others proved the unquestioned value of blood? They certainly had. "And blood — blue blood, if you please — is wanted in the herd," said Mr. John Winslow to his father. Said the son: "Father, we have never had the influence of a good bull in our herd; we have used the common grade stock of our neighbors. It has brought us nothing of value; the calves are without merit, and the heifers are like the other poor ones of the community. We have got rid of 6 of the herd; let's buy a young bull that we can use on the remaining cows, that will bring us something worth having; let's buy a bull from a splendid, pure-bred cow of dairy type, sired by a bull that has proved himself a breeder. Think what it means. Too many men think only of the cost of a bull in money; the value of a bull is measured down through future generations. The first calves have 50 per cent of his blood; and, if he is a good breeder, he should wonderfully tone up our herd and greatly add to our milk and butter record. This is simply the experience of the best breeders in history. We can use this sire on our herd and the stock of the neighbors for two or three years, and then sell him while he is vigorous and valuable; and then buy another not closely related to him, to breed on the old cows and their daughters. Instead of buying a $20 grade bull, let us seek a pure-bred one, that is a good individual and well bred, and pay the price. We ought to get a good one for our purpose for $100; but let's get the right one, anyway."

If you have a son, a partner of yours, who is earnest, business-like, industrious and intelligent, you had better do as old man Winslow did, and let him take the lines in his hands; if you don't, the chances are you will be sorry.

So the hunt for a bull began, and it ended in the purchase of an animal of a style and quality that neighborhood had never seen before. He proved a breeder, as had been his sire before him; and his calves showed constitution, style and quality.

The second year the Winslow herd averaged 250 pounds of butter, and things were generally improving. The old gentleman began to see more uniformity in the cows, in style and make-up. The calves, he said, were just like so many peas. They used to wonder what sort of milkers the heifers would develop into. Then began the study of calf form and calf udders. It was seen that some of the calves had not only well-developed udders, extending out front and behind, but they also had the thin thighs so essential for room between. Those were good signs, thought John.

In New England, more than elsewhere in America, feeding stuffs are high in price, because in the main they are produced far away, on the fertile lands of the west. The farmers bought prudently of grain, and many gave painstaking study to the relative cost of feed stuffs and their value in combinations. There were men about Rockdale who were intensely interested in what they fed their cows, but they had not reached the point of learning whether they were feeding profit-producing cows, or not. Winslow senior always watched the grain bin, much as did his neighbors; but, until his son brought new ideas to his attention, he had quite overlooked the significance of the individuality of the cow. The Minnesota experiments of Hæcker had interested him greatly. Later on, Professor Beach of the Connecticut Agricultural College published some experiments of the same kind, that he thought were even more telling than those of Hæcker. Beach had 50 cows, which he divided into three groups. There were 35 classed as of the dairy type, which, from the pictures, resembled some in their own herd which John said had the proper shape; some others had shallow bodies, and lacked belly and digestive capacity; while 8 others were smooth and fleshy of type. These cows had credited to them 103 annual milking records, 80 of which were produced by those of the dairy type.

The results secured showed clearly and decisively that the dairy type was the money maker. The little pamphlet which contained this report expressed it in figures this way: —

	Number of Cows.	Cost of Produce.	Yield of Butter Fat (Pounds).	Profit.
Dairy type, ...	35	$54 43	301	$28 09
Shallow body type, . .	7	49 42	201	5 81
Fleshy type, ...	8	50 50	206	6 09

In discussing this report with his father, John said: "We do not pay attention enough to the character and type of the animals in our herd. There really is not a great deal of difference in the cost of the food which the different kinds of cows ate, but see what a difference there is in what they produce. Those dairy type cows made an average profit of over $20 more per head than the other two kinds. Here it states that one of them made 511 pounds of butter, which yielded a net profit of $57.25. In my opinion, too many of our dairymen are forgetting that feeding is secondary to breeding; that they first must have the right sort of cow, to get the best kind of results. This bulletin ought to be read and studied by every dairy farmer in the State."

The records of the Winslow herd were improving steadily. At the end of the third year the books showed that the cows had averaged about 275 pounds of butter fat, while the cost of feed had not grown. Some of the heifers, soon to be fresh, were full of promise to John. "We'll aim high," said John, "and breed this up to a 400-pound herd. Why not? Plenty of cows have done that well in some of our great herds. The Guernsey cow Lily Ella produced 782 pounds of butter fat; and it is said that Pauline Paul, the Holstein, made 1,153 pounds of butter; while there are many Jerseys that have produced sensational records. Yes, I guess we can make it 400 without much trouble. That's the sort of production that makes profit."

Young men of energy and brains, no matter what their business, want to know what the other fellow is doing, and how he does it. This has a general application, irrespective of business. The farmer's institute grew out of this feeling. The institute is an educational medium to help farmers; under right conditions, it introduces new ideas into a community. Consequently, when the first institute was held at Rockdale, the Winslows took a lively interest. They could not help it, because the dairy cow was up for discussion. The principal speaker was a great dairy authority, who had two characteristics of a delightful sort. Next to telling a good story, he most enjoyed talking about the cow. He told some mighty truths, even if he did say that whenever he saw a cow he wanted to take his hat off to her as though she was a lady. John got some new inspiration from him, and came away surer than ever that he was working in the right direction.

Five years after John's return home the herd had come up to an average yield of 350 pounds of butter fat, and the three-year-old heifers were beauties, for the bull first bought had proven a great breeder. He was sold for almost what he cost, to a neighbor; and then another of the same breed, of somewhat different blood lines, took his place. He was of the same type and character; and thus they hoped to continue the uniform development of the herd. It gratified John not a little bit that a neighbor should want to own the old bull, for it meant that the gospel of good breeding was spreading in the community.

The health of their stock had been good ever since the new administration began. The lessons which he had learned from the college veterinary instructor had been helpful on occasions, and simply emphasized the useful character of his training during those four years. Milk fever, the dread of all dairy cattle men, had visited him but little. His motto was, "An ounce of prevention is worth a pound of cure;" so he fed cooling, laxative foods before and after calving, kept the cows clean and in healthy condition, and then acted quickly if sickness occurred. Later on in his career, when he had many heavy milkers, he adopted the method of injecting sterilized air into the udder when milk fever occurred, and with highly gratifying results.

As the herd grew in age and quality, the subject of future improvement was never lost sight of. Good dairy literature found its way on to the sitting room table, including both experiment station publications and dairy and live stock journals.

One day at the dinner table John surprised the family by announcing that he was seriously considering going to the World's Fair. He would enjoy the change, but he said: "Father, I would like to see the dairy cattle test, and study the cows there a bit. As those animals represent select ones of different breeds from over the country, I should like to examine them, and study both type and breed." "Well, if I were you, John," said the elder, "I would not only see those cattle, but would stop at Syracuse and Rochester and see those two herds of Firth and Bogswell. We have read a deal of them, and of the remarkable records some of their cows have made, and it might pay you to stop en route and see them; you might pick up some ideas on breeding and management."

This accounts for John going away on a vacation in July, after the haying was finished,—a thing he had never been guilty of before. He felt kind of guilty as he was driven to the station, all dressed up in his Sunday best, for he knew the folks home would have do his chores. But he believed it would pay. He did not realize, then, like many another good brother, that travel is a great educator in itself; he learned that later. As he sped across country in the rapidly moving train, through fertile valleys, over rich bottoms and along by rolling uplands, he saw many herds of cattle, kept mainly for milk production. He was greatly impressed with their variation and their apparent inferiority, even when seen from the cars; it was a revelation to him. In later years, when travelling through the green pastures of England and Scotland, among the many uniform herds there, his mind harked back to that trip across American soil on that warm July day. The contrast was striking, and he felt full sure that it was educational in its effect. If some of his fellow countrymen could have seen these sights, as he did, he was sure they would have taken the lesson well to heart.

The Exposition reached, the cows soon came in for examination. They represented both dairy and general purpose type; but it impressed him that, from the point of dairy value, the closer the cows adhered to dairy type, the better they ranked in production. There were exceptions, but the average of a class was what he judged by. From the profit point of view, he saw more money in the udder of capacity than he did in the thick buttocks and meaty back and breast. The working dairy records were also demonstrating that one class gave better returns than another. He was particularly impressed with several individuals, not so much for breed as for dairy character.

On the return home a short stop was made at the two herds referred to by his father, and here he saw many great cows of wonderful capacity. He noticed that these men had unusually well lighted and ventilated barns on their farms; and he saw their advantage, knowing that tuberculosis, that dread disease among cattle, would not thrive in plenty of light and pure air. He also noticed that the calves were provided with nice, healthy pens, where the sun in winter could reach them. These stables were not especially expensive, but they were sanitary, furnishing absolutely necessary conditions for producing the best grade of milk. The stables were clean, the cattle free from dirt and dust; and, though kept in during the day in this hot July weather, on account of flies, they were in clean, healthful surroundings. These two farms sold milk to a very particular trade, one of them shipping to New York City. Recent years have seen patrons of milk producers calling for far more care in milk production, giving them an essentially germ-free milk. To show how particular some buyers are, Mr. Frith showed John a letter, of which the following is a copy. It beautifully illustrates how some innocent residents of the city may have been educated beyond present day possibilities. The letter read: "Please ship me two quarts of pasteurized milk from a cow whose bag has been washed in peroxide of hydrogen, and wrapped in antiseptic cotton during the heat of the day. I desire this from a cow that is given distilled drinking water, and is fed microbe-disinfected meadow grass, free from noxious weeds. Also, see that her temperature is down to 80° F. when she is milked. See that the stable is thoroughly disinfected daily." "Certainly," thought John, "I did not begin my education any too soon."

These herds showed strikingly the effects of careful breeding. He noticed the bulls used were short-legged and strong-bodied, with much quality. He found that the owners used sires from dams that had udders of very superior shape; and they stated that the daughters of these bulls tended to reproduce through them the mothers' characteristics. Bogswell brought out a ring of four grand cows,—he called them "The Big Four,"—and lined them up for his inspection, the udders well displayed. He marvelled at their size and apparent capacity. The owners laid much emphasis on the part the bulls played in fixing this type. Bogswell more than once said: "Mr. Winslow, the bull is more than half the herd,—yes, sir, more than half the herd."

John reached home after ten days of what seemed to him to be a most profitable and enjoyable trip. At the supper table that night he began the story of that journey, and the lights didn't go out in the sitting room till far later than was common in the Winslow family. "John," said the old man, "what made the biggest impression on you in that dairy cattle barn at the fair?" "The dairy type," said John. "I was satisfied, after my inspection, that these smooth, meaty cows could not do the business we want done."

Later that fall the final report on this Exposition herd of 10 different breeds was made. The father, after supper one night, pulled the wrapper from his "Dairy Intelligencer," and read the results of the test. Looking it over, he said: "John, your judgment on the Exposition cows was good. Hear this from the report about results. A Guernsey, Mary Marshall, produced in six months a butter profit of $59.40, ranking first. A Red Polled cow, named Mayflower, of a very milky type, which I remember you especially told about, stood second, her butter making a profit of $52.10. Excepting for this one case, the other cows of the first ranking 10 were all cows of dairy breeds. Where the total record of 5 cows in each breed is recorded, I see that they show the Guernsey first, with butter fat worth $230; the Jersey second, with $225 credit; the Ayrshire third, with $218; and the Holstein fourth, at $211. From the butter point of view, the dairy breeds beat the others out of their boots. We had better stick to our type, and work deeper into the breed, my son." "Yes, father," said John, "I believe it is absolutely essential, if we are to get the very best dairy results from our herd, that we must stick to cow type, and never lose sight of its importance."

Seven years had passed by since young Winslow returned to the farm. The herd had gone through a remarkable change. In the process of selection, culling out and breeding up, the butter yield had increased from 180 to 400 pounds a year. The merits of the cattle were becoming known the whole country round, and the farmers of the neighborhood really began to take a just pride in the Rockdale herd. In fact, the herd was known far more than locally; enterprising agricultural journalists had discovered its existence, and had advertised it over a wide territory.

One day the neighbor who had purchased the first bull John had placed at the head of the herd made a call and engaged in conversation. He was a fairly good man, but, like many other persons owning stock, gave his herd less careful attention than good business warranted. He not only knew the Winslows laid great emphasis on the importance of correct breeding, but he was well aware that the Rockdale herd was carefully fed and attended to. He recognized the fact that his own cattle looked thinner in flesh, more ill kept, dirtier and more starved than those of his now prosperous neighbor.

After passing the customary comments on the weather and crops, John remarked: "Mr. Lee, that bull you purchased of us sired a likely lot of calves for you, didn't he?" "Yes," said Mr. Lee, "he certainly did. The heifers now in milk are better than anything we have ever owned before. Still, it seems to me that our herd is not doing as well as it should, and our cattle are not in the condition that yours are. I have been wondering how much feed and care had to do with this difference. Our barn is fairly warm and comfortable, and yet our cattle do not look thriving." "How about your feeding and grooming?" inquired John. "I feed plenty of hay and straw," was the reply, "but I never have felt that we could afford to feed much grain; the cost is too great. We don't use much provender, I know."

"It is sort of curious," remarked the junior member of the Winslow firm, "but I have just been studying over a pamphlet which I received from the Cornell University Experiment Station. You know that we have in the different States agricultural experiment stations that are working in the interest of the farmer, studying problems in soils, fertilizers, feeding stock, etc. Each of these stations publishes several times a year bulletins, as they are called, which tell about their experiments; these are free to those who desire them. The professors at the agricultural college used to make students study over some of the more important bulletins, and since my graduation I have been getting bulletins from some of the States whose publications I thought would help me. Now, in this bulletin Professor Wing and Mr. Foord tell of 'An attempt to increase the fat in milk by means of liberal feeding,' which is somewhat in the line our conversation has fallen into. They planned an experiment to find out whether a herd of dairy cows, previously kept under adverse conditions, could be made more profitable by better feeding and care. So they went out into the country near the station, and found a herd of 21 cows, with a reputation of being poorly fed, that had been on the same farm for some time, that had a large proportion of comparatively young animals, most of which had calved as nearly as possible at the same time. In this herd only 4 of the cows were more than eight years old; all but one had calved within a period of two consecutive months; and all were thin in flesh, much as yours are. Like yours, they represented native and mixed breeding.

"The experiment then begun by the station ran somewhat like this: A record was kept of the production of the herd in milk and fat for one entire milking period on the farm of the owner, without in any way changing the conditions under which the animals had lived. The man who owned the cows, Mr. Gibson, fed and cared for them just as he had always. The station arranged for him to weigh the daily milk yield, and take frequent samples of the milk of each cow, which were once a week tested for their butter fat composition by a representative of the station. After the first milking period was over, 10 of the cows were bought by the station and taken on its farm, where they were cared for and fed liberally for two years. A record was kept of all the food they ate, and the milk they produced was weighed daily, and its fat composition measured. While these cows were being studied, the other cows left on the Gibson farm were also being studied, just as they were the first year.

"On the fourth period of milking the 10 cows they bought were taken back to the Gibson farm, and again subjected to the same conditions they were under when the experiment began. During the second milking period at the station they fed the cows all the easily digested food they would consume, without getting them out of condition, economy of production being not considered. During the third milking period they tried to feed all the coarse fodder each cow would readily eat, and all the grain that could be eaten in addition, such as would give return at the pail. I might say here that this third method really represents our policy at Rockdale farm, — to feed liberally, yet economically. These cows for coarse fodder were fed red clover, timothy hay and silage. When the cows were on pasture, they also got a grain ration, until the milk yield became very small.

"Now, what was the result of this careful experiment, covering four years, bearing, as it did, on the health and vigor of the herd and its producing capacity? Well, I notice in the first place that the total yield of milk and butter fat was in nearly every case very much increased while the cows were at the experiment station, under satisfactory care. Of the 10 cows, it is shown that by liberal feeding the yield was increased 46 per cent in milk and 55 per cent in fat. These 10 cows were not the best in the herd of 21; they simply represented the average of the herd. Here is a fair sample of the way those cows did, taking Polly for example: the first year she produced 3,143 pounds of milk and 177 pounds of fat; the second year she produced 5,526 pounds of milk and 346 pounds of fat; the third year she produced 4,802 pounds of milk and 283 pounds of fat; the fourth year she produced 2,945 pounds of milk and 184 pounds of fat. Some of the other cows show an even greater influence from feed and care than this.

"In regard to the cost of the milk and fat during these different feeding periods, it is interesting to note that the average cost of 100 pounds of milk the first period on the Gibson farm was 53 cents, the fat being 12 cents a pound; the second period, when economy was not considered, it was only 65 cents per 100 for the milk, and 14 cents a pound for the fat; while in the third period of good feeding the cost was reduced to 45 cents per 100 for the milk and 10 cents a pound for the butter fat. Another interesting thing in this bulletin that I see is the difference in the appearance of the cows, due to generous feeding and care.

"It seems to me that this bulletin teaches an important lesson to us dairy cattle men; for it proves, by a four-years active trial, that liberal feeding not only pays in increased production, but it also pays by a more vigorous development of the herd. If the herd is more vigorous, then this vigor is transmitted to the offspring. In my opinion, too many dairy cattle men fail to see the relationship of ample feed to proper nutrition and continuous herd vitality."

The average man is fair minded, and is willing to be influenced by a rational presentation of facts. The contents of this bulletin, as presented by John to Mr. Lee, made a deep impression on his mind. Said he: "John, that is a good piece of work those agricultural experiments have done; and I believe enough in the results which they have secured to profit by it myself, through better care and more generous feeding of my own herd. I am mighty glad that I happened to drop in on you this rainy day."

There are many things which go to make up success in any one's business and life, but some of them are of more importance than others. John Winslow is a fair representative of many a bright New England lad of parts, who is ambitious to be useful and earn a living on a better standard than the commonplace employ. He was fortunate in a father who was disposed to aid and assist him in a useful education, and who was willing to put his education to the test.

John Winslow is a young man yet. The herd, which is yet one of partnership, has increased in its production capacity from 180 to 400 pounds of butter a year. While the cows with heavier yield eat somewhat more food, the degree of profit is far greater than excess of cost of production. In discussing the situation the subject of this narrative said: "It is not a difficult thing to develop a profitable herd. It goes almost without saying that the average cow is a consumer, rather than a producer. My own experience, covering but a comparatively few years and several generations of cow life, demonstrates to my entire satisfaction that the foundation of successful herd development rests primarily on breeding to proper type. A large degree of my success has been due to breeding consistently and persistently to that purpose. A suitable bull in type and breeding will yield results of no uncertain character, if mated to cows approaching the deep-bodied, full-uddered dairy type. I recently read an article by Hark Comstock on improving the dairy cow, in which he expressed some truths that have had much application in the improvement of the Rockdale herd. He says: 'According to the statistics of the Department of Agriculture, the average dairy cow of the country gives 130 pounds of butter a year; in the dairy demonstration now in progress on the World's Fair grounds at St. Louis, the entire Jersey team of 25 cows has averaged more than that in 60 days. Admitting that better care and better feed have to do with the question, there yet remains a very wide margin, that can only be credited to the functional capacity of the cows bred in the bone. When farmers began to select their bulls from pure-bred herds, possessing these great dairy values, letting the beef question and all side issues take care of themselves, they began to establish improved machinery in the shape of dairy cows. Nearly 12,000,000 cows are devoted to butter making in the United States, and the product in round numbers is 1,500,000,000 pounds of butter, worth, at 18 cents a pound, $270,000,000. Suppose that each of these cows could produce a heifer calf by a high-class Jersey bull, and the improvement in butter capacity for the new generation was even as little as 5 per cent, which would be an exceedingly small estimate, the increased butter output for a single year, assuming that the price was not lowered, would be worth $13,500,000, — a net profit over present income due solely to the use of improved cow machinery.' This improved cow machinery referred to by Hark Comstock is due to the patient and intelligent efforts of a comparatively few breeders, who have developed individuals and families of great productive capacity, whereby the mass of breeders may improve their herds. It is due to the work of such men that the improvement of the Rockdale herd has been possible in so short a time. To them American stockmen owe a deep debt of gratitude. If our herds are not productive and profitable, it is due to neglecting the opportunities provided through the agricultural college, the experiment station, dairy and live stock literature and the help of intelligent breeders. These all point the way toward success."

In drawing this narrative to a close, it is unnecessary to concern ourselves regarding the identity of the subject of the sketch. He still lives on Rockdale farm in fair New England, where he continues to work among the herd he loves so well; for his is a labor of love, not of sufferance. He has been an unconscious instrument in uplifting the agricultural dignity of his community and State, while he stands as a strong example of what a man may do to demonstrate the usefulness of the modern agricultural education. You may not know him personally, but as the years go by you may discover his counterpart here and there when perhaps least expected. If when in future you chance upon a superb herd of dairy cows that appear to you much what those of the Rockdale herd were at the completion of this narrative, should you then investigate, I am sure you will learn some valuable lessons, even if you are not keeping the cattle of Winslow & Son.

The CHAIR. Who will begin the discussion?

Mr. B. P. WARE (of Marblehead). The lecture proves what I have known from my own experience for many years, and what I have had the honor of stating before this Board and the farmers' institutes many a time, — that a large portion of the cows in New England do not pay their board. The portion that is profitable has to support those that do not pay their board, and of course it lessens the profit very much. I am very glad that the lecturer has emphasized the importance of the bull in getting milk-producing heifers. I believe, although it is very important to have a good cow, it is of greater importance to have a bull of a superior milking type, in order to produce heifers and cows that will make profits. I have had some little experience in breeding, and I have observed the great influence of the bull upon the milking quality of the progeny. Dairy farmers, how many of you have a bull at home that should be improved? How many of you have a herd a large portion of which is not paying its board? Wouldn't it be well for you to send John to our Agricultural College, that he may come home and instruct you how to develop and improve your stock?

The CHAIR. At one of the fairs this autumn, where it was my good fortune to judge the stock, there was one herd of Jerseys that had all the types, which has been raised by one man. We would like to have Mr. Kilbourn say a word.

Mr. W. A. KILBOURN (of South Lancaster). The herd under my care has constantly and steadily improved. I can report very successful records, for our main object is to supply the very best of butter and milk and cream that we can make; and we have continued for many years to raise our own heifers and make selections from year to year, dropping out any that prove inferior, and securing from time to time bulls of the best type that we can find, and this has resulted in a good, well-standing herd, although not noted for the remarkable records that are produced in some instances. I think we may say that we have a fairly good-looking, fairly productive and satisfactory herd.

Mr. J. F. BURT (of Easthampton). In regard to those 10 Gibson cows, I understood that the agricultural college experiment did add to the butter fat. We have been told at our colleges that you couldn't increase the butter fat, no matter how well you feed the cow. Will the lecturer explain?

Professor PLUMB. This experiment, you will remember, was rather unusual, and entirely different from anything that has been conducted before, in that the cows were tested under adverse conditions at one time, and then they were simply brought right over to another type or condition, so that the effect may have been partly due to the condition as well as the food.

Mr. BURT. If you were trying to build up a nice herd, would you breed in the same line, or cross-breed your animals?

Professor PLUMB. If there is any impression I dislike to give in coming before an audience of farmers, it is that I am a theorist. Now, I do have very pronounced views on the question of crossing stock, and I would like to be able to demonstrate in a practical way that my views are good, sensible, practical views. There are various ways of doing this crossing, but, on the basis of the investigations that we have available up to this time, it has been pretty well demonstrated that the crossing of two distinct breeds beyond one generation is almost always detrimental, and results in setting free in the system of the individual following the third generation, and so on, characteristics and qualities which can be traced back twenty-five or fifty years or so. No; there is only one case in my mind where a cross-breeding of a breed is justifiable, and that is where you are crossing it with the butcher.

I have had the pleasure of seeing the dairy herds in a general way in that part of the country which lies east of the Mississippi River, from the Gulf up to the Canadian line, and I have made some very extensive trips among the herds and flocks of Great Britain, spending a great deal of time among the farmers and stock. The difference between the United States and Great Britain is a very striking one in the character of the stock which they have. You can start out from London on the train, and as you go out, the first thing you know you are in a new country, apparently, in the matter of stock. You find yourself in the Ayrshire country, and you see scarcely anything but Ayrshires, and what they call store cattle, for the butcher. You go down on the islands, and they all evidently breed only pure-bred animals, like the Jersey on the Island of Jersey, and the Guernsey on the Island of Guernsey. You go down to Hereford, Eng., and you see nothing but Herefords. You go down to Devonshire, and you see nothing but Devons. You go up to Scotland, and you see nothing but Shorthorns. And these are all pure bred. As you go over that country, you cannot but be impressed by the fact that the breeders there have very fixed ideas of the importance of unifying a type of breeding.

But how is it in this country? You can take the Boston & Albany Railroad, and go west, and if you don't see more styles and colors of cattle than you can find anywhere else in the world, — and I don't care how far west you go, —

then my views are not worth anything. You can go through New York State and you can find a dairy farm, and there will be four breeds on the farm. Of course they all represent more or less cross-breeds. You go to Ohio, and you find the same thing. You go to Indiana, and you find the same thing. And it is an unfortunate thing.

To make my point a little more emphatic, I will say that all the records are in favor of great protection against impurity in breeding. But there isn't a State in this Union but what, if it raised only one breed of cattle, such as is done in Great Britain, would draw the buyers of the rest of the country. If all the cattle bred in the State of Massachusetts were Jerseys, or were Guernseys, or were Holsteins, — I don't care which breed you take, — if this State had a reputation for a fixed line of breeding, you would find hundreds of buyers coming from all over the country to buy. Why? Because buyers understand they can find that particular breed here. But if you have a region where there are all sorts of blood, and very little, if any, that is definite, you will find that buyers are more scarce. I hold, besides the practical value, you can introduce a selling value of an animal from purity of blood, rather than otherwise. It costs no more to keep a pure-bred animal than a grade; and there is no reason under the sun why you shouldn't get as good, and even better, results.

Mr. Ware. I understood, Mr. Chairman, that the stock that this famous farmer who has been spoken of had, was common stock and a pure-bred bull of good type; so, farmers, you may improve your product with the cows you have by securing a pure-bred bull. I admit the value of pure breeding, but we farmers, as a general thing, have our common cows, and we want to improve them.

Professor Plumb. Please don't misunderstand me. The question asked me about crossing was about the crossing of breeds. In this case it is the improvement of the breed by means of a pure-bred bull, — by breeding up, which isn't cross-breeding. In this way you can get a herd that is essentially pure bred. This is practical to any one.

The Chair. Mr. Sagendorph has quite a large herd of

Guernseys, and his heifers, I see, are doing very well. Will he please tell us something about them?

Mr. Noah Sagendorph (of Spencer). My son is making a specialty of Guernsey cattle; he endeavors to raise from the very best of Guernsey stock, so that he has some from everywhere where he has found a good animal. At my farm I keep Guernseys and Holsteins. In the first place, while my boy was at Cornell I began getting Guernsey cattle. Of course I had to have an outlet for milk, and all at once my customers began to find fault with my milk. I endeavored to find out what the trouble was, and they couldn't tell me, only they didn't like it. I bought some Holsteins, and found that my customers all liked the milk. I have since been breeding at my farm pure-bred Holsteins with Guernsey cattle, and now and then a Jersey or a grade Jersey. My preference from the beginning has been the Guernsey cow, but people don't like to drink the Guernsey milk.

Ex-Secretary Sessions (of Springfield). The deduction which we may possibly draw from the discussion between Mr. Ware and the lecturer is that a pure-bred bull is all right, anyway. I want to know, Mr. Lecturer, if that is the position you take?

Professor Plumb. I think I stated that it should have merit with the pedigree; physical merit should be considered, as well as inheritance. Therefore, any pure-bred bull wouldn't necessarily be a desirable animal. I have seen pure-bred males where I would a good deal rather have nothing, or some grades. I don't know how it is in the State of Massachusetts, because I have never had anything to do with buyers of stock here; but I have bought and sold dairy cattle for nearly twenty years, and this has been my experience invariably, covering three States: most everybody wants to buy as cheaply as possible, and it is a rare man that ever makes any inquiry as to the merits of the sire or dam. The first thing is, "I have $25 in my pocket; what can you give me for $25?" — without looking into the future at all. Now, in such cases the need of education is apparent, because, as I heard one man say, "One loses sight of the gold dollar, backing the cent up in front of his eye," when he fails to see the significance of superiority in breeding and individual merit to head his herd. I have seen examples on both sides, and I never saw an example of a poor individual which won out, and I have seen many examples of fine individuals that brought prosperity to the farm.

Mr. **John S. Anderson** (of Shelburne). This question which we have been discussing here to-day has been discussed for many years; it has been brought up year after year in this Board. The lecturer tells you that in England they devote themselves in a certain locality to a certain breed. That is true, and that is the way we ought to do; but we Americans dabble in everything, and amount to not much of anything. In England it is quite different. There was Thomas Bates, the champion breeder of the world. He showed the world that there was such a thing as the dual purpose cow. He bred the finest Shorthorn cattle that have ever been bred by any man, — cattle that were good for beef and good for milk. Professor Sanborn of New Hampshire tells us that we can have the beef animal with milk qualities. You gentlemen do not believe it, but I tell you that I know it.

The lecturer has done well, but he said nothing about the problem of the calf. There is something beside the cow. A neighbor, who bought a cow at my place, got a calf which at eight weeks weighed 250 pounds. He sold that calf for $25. Was not that quite an item in his favor?

When we used to raise steers they brought us good money. They sold last year for $100 apiece. We sell our heifers for from $150 to $250. Doesn't it pay? Our people are going back to it. They have seen the folly of raising a special purpose cow, and they are going back to the good old substantial cows.

Professor **Plumb**. I was discussing the dairy cow, and it is hardly fair to call me up because I didn't champion the dual purpose cow or the beef cow. Each of those has its place, but I propose to bring the strongest arguments I can to bear when talking about the dairy cow. That is the reason I spoke as I did, with all due respect to the dual purpose cow, of which I have a very high opinion.

I wish to say, in addition to my argument in behalf of the dairy cow, in this discussion of the dairy cow as a producer, that, while you can find isolated examples of a dual purpose animal making a better record than certain dairy animals, in all the competitions that have taken place in this country, on any important scale, — at the World's Fair, I will say, where the biggest things have been undertaken, — the dairy cow is the one that has made the most money. Now, I do not say at all that it would not be a fine thing for a man to have a herd of Red Polled, for instance, as they are the recognized dual purpose cows; they make a lot of money. But the dual purpose animal, if you please, has a very considerable advantage, so far as that type is concerned, in its additional value as a cow.

I will also call attention to this, that, in my argument in connection with the cow Mayflower, I referred to the fact that this cow belonged to a very distinctive and remarkable dairy strain of Red Polled cattle. I know the man who has done more to bring out this strain in Red Polled cattle, and it will apply to Mr. Anderson's herd of Shorthorns, — that the more profit that comes from those animals that he refers to as large milk or butter producers, the more are they after this dairy type. There are exceptions, as illustrating the fact that there are exceptions to the rule; but nevertheless it is true that this type of animal, whether Shorthorn, Red Polled or what, makes the most money in that breed.

Mr. ANDERSON. I say that the farmer who goes into the business of raising milk, and follows the dual purpose cow, will make the most money. He has two strings to his bow, — he has the milk and the beef. We had a pair of cows that made over 1,000 pounds of butter in the winter, and one of them dressed 2,400 pounds and the other 2,300 pounds. They were not of the dairy type, for if they had been they never would have dressed that and brought the price they did in the market. My cattle are not of the dairy type.

Professor PLUMB. There is a great difference between the Bates Shorthorn of former days and the Shorthorn that is in the United States at the present time. It is running to a rangy type of cattle, and Thomas Bates all his life long made a special study of the dairy development of his cattle.

Mr. Sagendorph. As I understand Mr. Anderson, he claims that at the end he will get more from a dual purpose cow than he can from any other. I will admit that when you get through with a Guernsey or a Jersey cow you have hard work to sell her, — the butchers won't buy her. The meat is so yellow, the butchers tell me, that people won't buy it, and therefore you have to get rid of the cow otherwise.

Mr. Van Norman (of West Newton). I think we have wandered a little from the subject. I would like to say a few words on the general subject of the practical dairy cow. Professor Plumb in his very agreeable narrative told how one young man produced certain results by choosing a bull from stock recognized as being of a type that brought forth producers, thus securing the results he was after. In an experience commencing some few years ago, I was impressed by the desirability of following blood lines. I was sent to buy a herd of Jerseys, and I never had bought a Jersey cow in the world; what little experience I had was with the Holsteins. I went into a noted herd in Pennsylvania and bought 20 animals, and they averaged 6,344 pounds per cow the first year. Every one of those cows was selected because of resemblance to those of their own family which had been producers. If you want to make a selection of heifers which will be big producers, choose practical dairy cows that most resemble in type and in family characteristics the best of their connection. If you are going to breed the practical dairy cow, you must learn which animals of your selection carry most uniformly the quality you want, and in seeking that quality you will find that certain families can be depended upon because of their resemblance. Wherever you find one that has the strongest resemblance to the best producers in that family, you will usually find what you want.

That is the trouble in cross-breeding. You will find in one family the distinctive characteristics that more often accompany the good quality that you want, goes with a certain shaped head, or face, or horn, or some other distinctive feature, and in another breed you find some other quality. Now, you mix those two, and you cause, it seems, almost a war of prepotent characteristics; and the result is, in two or three generations, you get something that is neither fish nor flesh.

Mr. E. A. **Waters** (of Worcester). There is a place for the young man in the business of breeding and raising stock in New England, whether it be pure bred or grade. The man who loves the business, is charmed by it, takes an interest in it, will succeed. It requires just as much time and about as much talent in breeding and raising a dairy cow as it does a trotting horse. Even if the calf is a good animal, it won't grow up into a good cow unless you take care of it. I have found, in my experience with cattle, that a first calf needs considerable attention to make a good dairy cow.

To-day there are forty men looking for good stock where thirty years ago there wasn't more than one. Men of wealth, having accumulated a competency, buy farms and small places, and want to keep a cow. They want a good one, and they don't care what they pay for it. I claim that a man starting in wants a good sire. The sire is more than half the herd. He can succeed with the business, if he knows how. One great trouble with us farmers has been, is now, and will be for all time, the difficulty we experience in getting good milkers. I don't know as it makes any difference how a cow is milked, whether cross-wise, her fore quarters first, or her hind quarters first; but I do know that it makes lots of difference how you sit down to milk her, to make a good cow of her, when she is young. I found that out several years ago, and it is hard work to teach a man who doesn't know it. One-half of the farmers to-day are poor milkers.

Mr. N. I. **Bowditch** (of Framingham). As I have been listening to the discussion, this thought has occurred to me. Why can't we do something to develop a certain breed of stock that shall be renowned in this State and the country and the world over? The speaker has shown, it seems to me, that we ought to confine ourselves to one breed of cattle; that is, it would be well for a community to do that. Massachusetts is a milk and butter State, not a State of beef cattle. Would it not be well for us to see if we cannot develop a breed of stock that shall be the kind that we want here, and the kind that it will be profitable for us to raise and sell? Will not the lecturer recommend to us that we offer at our cattle shows larger premiums for some particular breed adapted to the needs of our State?

Professor **Plumb**. Those are difficult questions to answer. I have been very much impressed with the fact that Massachusetts has had for over a hundred years a society that has been too little known in the United States. I know Massachusetts has done things that are very remarkable, in bringing cattle to this country and putting them out among the farmers for a mere nominal price, that date back a great many years. Personally, I don't believe it is a practical thing in any community to bring about very great revolutions, excepting by education. I think education is the thing necessary to growth among the farmers, both financially and otherwise. And the work of the experiment stations and the agricultural colleges in this country — and I would also say the agricultural people — is so great that it can hardly be measured, unless you have had an opportunity to look into the faces of thousands and thousands of farmers who are following the footsteps of the experiment stations working in this country to-day. They will call your attention to the fact that there are States west of you where a wonderful change is going on among the farmers, due to the researches of our experiment stations and the work the instructors are doing. The work in some of the western States is a perfect revelation, as compared to what it was ten or fifteen years ago. Hundreds of farmers' institutes are being conducted. I received a letter once, saying that farmers go thirty miles across the country, in sleighs and sleds, to attend the farmers' institutes. So I say that education will solve some of these problems.

Mr. **Bowditch**. I thought perhaps we would emphasize our practices by enlarging them in a special line, taking some particular breed of cattle that we can agree upon as a leading dairy breed; then we can increase that breed and improve it in this State. I believe it is feasible. I know that the men will disagree as to the breed, but I think we could get a majority in favor of some one breed. If we can do that, then I recommend that we urge our societies and organizations to concentrate their interest upon some particular breed, in order that we may improve it in this State, and make it as prominent as breeds are abroad. I appreciate what the professor has said, as does every one who has travelled through those countries. As you cross from England to Scotland, you know it as soon as you see the cattle; and they have made money by it.

Mr. SAGENDORPH. For my part, I want a stringent law made in regard to bulls. Every farmer who raises pure-bred cattle keeps his bull shut up, and every man who has scrubs turns them out; and the first thing you know, your neighbors come to you and say, "Your fences are down, and your cattle are running on our ground." It seems to me that we who are raising pure-breds should look into this, and see if we can't get a law that will compel the man who keeps scrub cattle to keep them at home, the same as a man does who has pure-breds.

Mr. S. H. REED (of West Brookfield). For a number of years I have done all I could through the State to make people with ordinary means think that they can improve their cattle, starting with what they have in their own barns. I want to say that I once heard of a preacher who was very successful, because he always made each one of his audience feel that he could be a hero. Our speaker this afternoon has made each one of us humble farmers feel as though we could start right where we are and rear a successful herd. About twenty-five years ago I had a cousin working for Mr. Waters, who has spoken here to-day. This cousin came to visit me, and he said: "Mr. Waters knows a cow so well that he can go to Boston and never bring home one that doesn't milk 20 quarts." Now, I have known Mr. Waters' record these twenty-five years. When he had a herd of his own he had 20-quart cows, and he has always been in demand to handle herds for people who wanted his services in bringing up a valuable herd. So we can see that, if a person has in his mind the right idea, he can make the right selections. Our speaker has clearly shown this afternoon that, with the material we have at hand and the bulletins that we have on this subject, the present generation is head and shoulders above the former one in being able to pick out that type; and if we set up the type that we know is valuable, the cow, the heifer, or the calf, then we are on the sure road to success. We have had a herd, I want to say, personally, and for twenty-five years have made it a cast-iron rule never to have a male in the herd that was not from a cow with a good record for milk, — say from 20 to 30 quarts; the dam must have been a 20 or 30 quart cow, and one that had good records for quality. So that, after these years, the individuals in my herd are as much alike as a flock of hens are alike to a feather, and it has paid us in that way.

One more thing I want to say, — I looked over into one of Mr. Anderson's pens, and saw seven animals, and Mr. Anderson said, "There is $700 for me." I got into that pen and picked out one of those animals, and brought him home, for $100. The neighbors all said a fool and his money were soon parted; but the first four heifers brought almost $200, and the bull calves that were sent all over the State paid me for him three or four times over, and after four years I sold him for just $200. That is just a simple incident, to show that Mr. Anderson breeds good stock. He wrote me that the dam of this bull which I bought had given 30 quarts of milk in twenty-four hours, and had made a little over 20 pounds of butter in seven days. It pays us to get those animals, and it pays us to study, so that we can carry that type and be able to pick out the profitable ones.

Ex-Secretary Sessions. I noticed with a great deal of pleasure that the lecturer did not attempt to "boost" any one breed. It was the principle that he was advocating here; and I believe that any of us farmers who wish to improve a breed of cows can do it along the line of our taste. If our taste runs to Guernseys, we can seek among the Guernseys for a sire to build up our dairy herd, but we must look for the dairy type. If our taste runs to the Jersey, the same course is to be pursued; we must go to the Jersey herd and look for this dairy type. If we have a preference for the Shorthorn, there are yet in the country Shorthorn cattle where we can select a bull of the desirable type. My observation and experience has been that, unless a man enjoys his work, he will never make a mark in it. Young men who desire to build up a dairy herd can adhere to this principle, and still follow out the line of their choice.

Mr. H. A. Turner (of Norwell). We have had a discussion of the matter of milk and one of the matter of cows. We don't settle anything, but in these discussions things are brought out that will tend in the future to improve and better our dairy herds. The amount of it is, farmers, we hear these discussions, and we know what we ought to do. Shall we go home and do it? Shall we go home and improve our cows at all? These are the questions.

Adjourned.

Evening Session.

Mr. Henry S. Perham of Chelmsford presided at the evening session, held in the Opera House, at 7.45 o'clock. The lecture was delivered by Hon. John D. Long of Hingham, his subject being "Methods and procedure in the National House of Congress." By request, the lecture is omitted from this volume.

SECOND DAY.

The meeting was called to order at 10.30 o'clock by Secretary Ellsworth, who introduced Mr. Isaac Damon of Wayland as the presiding officer.

The Chair. It is always profitable to listen to a man who has done something in the world, who has started thoughts along new lines, who is an expert; and it gives me great pleasure to introduce to you such a man, Professor Bailey of Cornell University, who will address you on the subject of "The advisability of agricultural education in elementary schools."

THE ADVISABILITY OF AGRICULTURAL EDUCATION IN ELEMENTARY SCHOOLS.

[Stenographer's Notes.]

BY PROF. L. H. BAILEY, ITHACA, N. Y.

I feel complimented to have the most important subject on the whole programme which has come before you. You are to listen to papers on farming, on the improvement of the cow, and other agricultural questions; but I take it that the most important thing, after all, is the boys and girls. Unless we have young men and young women who are interested in agricultural matters, and are more efficient than the parents are, we can scarcely expect to obtain an agricultural competence.

Some of you may have read a few days ago a statement in the press despatches to the effect that the great universities are to be in the great cities. New York City, according to these statements, in a generation or two will have a population of 10,000,000 inhabitants. The cities are to have great problems; the activities of the nation are to centre therein. The despatches state that students who desire to come into first-hand contact with the problems of life will take up what they call "the problems of the dark, gray city." The account also speaks of those self-sacrificing institutions located at New Haven and Ithaca and Princeton as being tremendously handicapped in their academic and university work because they have no great collections to which they can send their students, unless they build those collections with their own forces; whereas, in New York, Boston and Philadelphia there are great collections, there are great libraries and museums, and there are tremendous social and economic problems.

I suppose that it matters very little to us whether the great universities of the future are to be in the city or in the country. It is a tremendously important question to us, however, as to whether our civilization is to be dominated by the city, and whether all the economic forces are to emanate from the city, as distinguished from the country. And when I speak of the city and the country, I use the terms very much as the despatches seemed to use them,— the city meaning the metropolitan cities, the great cities, those of perhaps hundreds of thousands or millions of people; and the country including not only the farming country, but also the small towns and the small cities. The question is, is all human activity hereafter to centre in the city, the large city, the metropolitan city, or in the small city and the country? Or is it to emanate from the country as well as the city? I suppose it is true that the university of the future, like the school of the future, is to come more intimately into contact with the real problems of life. We are to deal less with mere books, proportionately, than we have in the past. I fear in many of our schools we are now giving more attention to books than we are to brains. If the university of the future and the school of the future are to exist for the purpose of making more resourceful every life that they touch, by bringing it into contact with the actual problems of living, then I wonder whether there is not a place for the university and the school in the country as well as in the city. Are there not country problems as well as city problems, and should not the institutions reach them first-hand, and not indirectly through the city?

I suppose more than half of all our people will always live outside of the metropolitan centres. These persons must be reached in terms of their daily lives, as well as those who live in the dark, gray city. There are those who live in the open, free country who have problems to solve, social, economic and moral. The school in the country is more and more to come into contact with the real problems of life. We are to turn out men who are to take up the actual duties of life from the point of view of educated men.

The foundation of this whole question is that inquiry which we so often make, Why is it that the boys and girls leave the country for the city? Why does the city entice and allure them? I sometimes wish I might turn the proposition around, and ask, Why should the boys and girls stay in the country? and put the burden of proof on the farm and the farmer. I would like to know what the farmer's answer would be, if he were put upon the witness stand and cross-examined upon that proposition.

I may say, in the first place, that not so many boys and girls, proportionately, are needed in the country now as were needed a generation ago. Fifty years ago it required in labor to produce a bushel of corn 4 hours and 30 minutes, — that much expenditure of effort, as measured in time; at the present time it requires to produce that bushel of corn 41 minutes of effort, as measured in time. Fifty years ago a bushel of corn cost 35¾ cents to produce, and it costs 10½ cents now. Fifty years ago it cost in time to produce a ton of hay 35½ hours; now it costs in time 11 hours and 34 minutes. Fifty years ago it cost $3.06 to make a ton of hay; to-day it costs $1.29. And the saving in human labor annually on the seven staple crops of the United States — Indian corn, wheat, oats, rye, barley, potatoes and hay — is something like $681,000,000.

By greater efficiency of farm machinery, and by greater efficiency in the organization of human effort and labor, we are able to accomplish more with the same unit of time than we were fifty years ago.

The cities have increased tremendously since that time; and it is an absorbing fact to us that the cities should grow and develop in wealth and power and influence. It is of interest to the farmer that the consumers who live in the city should be increased in numbers and in proportion, for they buy his products. Farmer boys have helped to make the cities, and the farmer should realize this fact, as well as the other fact, — that farmer boys also have made the farms.

But there are some special reasons why the farmer boys leave the farm. I think I may as well recite a few of these reasons. They are all familiar to you, but they all have a bearing upon the larger question of schooling, to which I am coming in a few minutes.

I will say, in the first place, that the old folks drive the boy away from the farm in many cases because they do not take the boy into business, particularly when he leaves college. Having had a good deal of experience, extending over many years, with farmer boys going to college, I have become convinced that the chief reason why many of the college boys do not go back to the farm is because they have no opportunity to go into business with their fathers; whereas, we nearly always find that the merchant or the manufacturer or the engineer expects, as a matter of course, to take his son into business with him. Perhaps he will only give him day wages, or hire him by the month, for the first few years; but the boy expects eventually, if he proves himself worthy, that he is to be associated in his father's business. A farmer will hold the farm until he is sixty-five or seventy years of age, giving the boy very little interest in the farm, and rarely a proprietary interest, mostly as a laborer; and the young man, therefore, having no capital and no opportunity to go into business for himself, goes to teaching or other work; and by the time the father gives up his work the son has increased his business so that he does not care to take up the farm, — unless, when he has secured a competency or adequacy, he goes back to the farm late in life, very largely because of his personal desire to do so.

In the second place, the farm is not always worthy of the educated and ambitious young man. Not so very long ago a farmer said to me, in a complaining way, that he had sent his boy to an agricultural college, and had hoped that the boy would come back to his farm after he had graduated, but he had gone off to the city and engaged in other occupations. I said, "If that young man had gone back to your farm, I should have thought his education had been in vain." The farm was scarcely worthy of the young man. The young man who has been to school has higher ambitions, a larger horizon; and the farm he left when he went to school cannot be attractive to him unless he has an opportunity to develop the farm into something better. If he does not have this opportunity, then he will see attractions elsewhere.

In the third place, the young man is ambitious for large things. Every young American is ambitious, and he sees achievement makes very largely from the city, and he thinks the farm is too small a field of action. In its larger economic and social aspects it is a very gratifying thing that the American boy does not necessarily follow the occupation of his father, whether his father is a farmer or lawyer or physician. He has full opportunity to follow whatever line of business he chooses; and I do not know why a farmer boy should follow the occupation of his father any more than a boy from the city should follow the occupation of his father. And I am wondering, if statistics were studied, whether we should not find, after all, that as fair a proportion of the boys, as they come and go, follow the occupation of farming as those who follow other occupations of their fathers?

Fourth, there is less financial risk for the young man in some other occupation. He works for others, or does not work for himself, and knows at the end of the week or month how much salary he is going to have, — a measured wage. He is learning something at somebody's else risk and expense. There are new concerns springing up in the city every day ; how are they formed? Nearly always they arise by two or three young men getting together and establishing a concern of their own ; often they have learned the business at somebody's else expense.

Fifth, there may be more money elsewhere. The farm returns a large rate of interest on its investment, but its investment is nearly always small. If you were to figure the rate of interest on the investment of any farm, — an ordinary farm, that merely supports a farm family, — I think you would find that the rate of earning is larger than that which accrues from almost any mercantile business, but the amount of investment is usually very small. The young man and the young girl on the farm ordinarily have very little money to spend that they can spend in the way they choose. Many times I have asked young fellows why they were dissatisfied with the farm, and they say, "Oh, I have no money to spend unless I have it to spend under parental authority and under dictation." And I say, "If you go to the city and receive five or ten dollars a week, it will scarcely more than pay your board and your clothes and room, and you won't have any more at the end of the year than if you remained on the farm." And nearly every time they reply, "That is so; but what money I have to spend I can spend in the way I choose to spend it, and I am cut loose from the apron strings." Whether or not that is a proper view for young men to take, I am sure that it is not an uncommon feeling.

Sixth, he is always attracted by the prospect of shorter hours in the city; he thinks he will escape drudgery when he goes to the city. I doubt very much if he will, in the great majority of cases; but he thinks he will.

Seventh, there is more diversion in the city, — social and intellectual entertainment, more going on, — that attracts the boy and girl from the farm.

Now, it may be that the young man or young woman is mistaken in all these matters; nevertheless, these are some of the points of view that actually do influence the young people in moving from the country to the city.

Now, let me come to my last point, which is the one that articulates this subject with the one I am to speak about this morning, — the tendency of the young man's teaching has been very largely away from the farm. There are three agencies that teach the young man and the young woman: first, the most important, is the parental influence; the second is the preacher; and the third is the teacher.

I am wondering if you ever heard at farm homes the farmer deploring his own business? I am wondering if you have ever heard him compare farming to other occupations, to the disadvantage of his own? I am wondering if the farmer is not likely to put forward the worst aspect of his business? I am wondering if the manufacturer or the merchant does not always put forward the best aspect of his business? If there is no pride in the farm and in the business of farming at the family fireside, I wonder how much you can expect there will be in the young person who grows up by that fireside? I am thoroughly convinced that a good many of the young men are turned away from the farm by the attitude of the farmer himself toward the business in which he is engaged. If any one needs to have a pride of calling, it is the man who follows the plow.

Then there is the question of the preacher. The old-time preacher confined himself very largely to the sphere of morals and religion; he was a professional person, set aside. At the present time the preacher is interesting himself not only in matters of religion with his flock, but also in the actual affairs which are going forward in his pastorate; he is taking an interest in the business of his people. He knows that, as the material welfare increases, their moral and spiritual horizon ought to widen; so you will now find ministers who are taking intelligent interest in the questions of the farm and in the questions of the school.

I received a letter a short time ago from a Massachusetts country parson. In regard to nature-study taught in their schools, he says: "I have four children, and can see the influence of the study upon them. Altogether, I am more and more convinced that nothing was ever put into our public schools that is of greater value and farther-reaching consequences." He says the children of his day were cruel, but his own children and those of his neighbors are not cruel. He says he attended a meeting at which the sentiment among the farmers and women was unanimous that nature-study as it was taught was something of great value; and he also discusses agricultural questions.

The teacher, as well as the preacher, has tremendous and far-reaching influence on every child with whom she comes in contact. I say "she," because nearly all the rural school teachers in New York State, and I suppose also in Massachusetts, are women, — a remarkable contrast, in this regard, with the old world rural conditions. It was my privilege this year to speak to a group of country school teachers in England. There were seventy-two, as I recall, in the room. Of these, but seven or eight, I think, were women, and nearly all of the men were older than I am. In other words, they had taken up the business of teaching country school as a profession, expecting to follow it all their life. They were enthusiastic and professional pedagogues. I wonder how many of the young men and young women who go into the rural schools of America expect to follow it all their lives, or whether it is not merely a makeshift? In one place I know that the school teachers are engaged sometimes for a period of ten weeks, and some of them for even a less time, and a majority of them are not engaged for rural schools for a longer period than one school year.

The teacher! It is the teacher's business to impress the child. The child puts itself in the hands of the teacher for the purpose — unconsciously, to be sure — of being impressed and guided; and the teacher's influence, therefore, is tremendous. And the teachers in our schools — I am not criticising our schools, because it is a condition that has gone through a long evolution — the teachers in our schools have very little touch with rural affairs. The teachers have been trained very largely from the town and city point of view, and are very often town and city persons. And the ordinary problem of the school books, — are they problems of the farm, or are they problems of the city? I wonder whether the problems of arithmetic, the problems of partnership, are given as often in the terms of the environment of the child as they might be? I wonder why they should not refer to the thousand and one things that pertain to the real life of the child, as well as those things which have to do with city conditions, with which he may have almost nothing to do?

Some two or three years ago Professor Barnes made inquiry of all the children in two agricultural counties in New Jersey as to what they expected to do when they were grown. At seven years of age, 26 per cent of all those asked said they were to follow some occupation connected with the country. He asked those at the age of fourteen years, of which 2 per cent said that they expected to follow some occupation connected with the farm. Between seven years and fourteen years the difference between 26 per cent and 2 per cent! What influences were at work all those years to turn the young minds from the farm? Professor Barnes says in this particular case he thinks it was due in a large part to the influence of the teacher, a graduate of the city high school, who went to the country school on Monday morning and went back again on Friday night, who dressed as the city person dresses, and who talked in glowing terms of the city, until the general drift of the school was cityward rather than countryward. This may be perhaps an exceptional picture. It may not be true in Massachusetts; it is true in some parts of New York State.

I read a very interesting address, a few days ago, in regard to universities. The speaker, who is of national reputation, put the influence in the universities not on the study of the subjects, but on the general drift of sentiment which was in the university, — the consensus of opinion on life; the moral, intellectual and spiritual tone of the whole institution. If you have a sentiment leading in any one direction, that sentiment determines the character of the institution. And I am sure that all of you who are school men will believe that that sentiment is tremendously important in the school.

I can conceive of a rural school in Massachusetts or New York State which is putting the children in intimate touch with farm life, which does not teach one bit of technical agriculture. Whether or not it shall put the children in touch with the actual problems with which they live, will depend largely upon the influence of the teacher conscientiously directing their attention to the real things with which they are to grapple. How many of our schools really touch so very much of the actual life of the child? The child lives in one sphere, goes to school in another and goes to church in another. I wonder whether these are not all phases of one type of existence, — whether one ought to emphasize more particularly one part of the life which the child ordinarily leads?

When I studied geography, I began, as I suppose most of the older ones began, with the universe; then I came down finally to the solar system; and got down to the earth eventually. We did not get a very firm footing on the earth; we learned something of the political divisions of the earth, and that was about all. Now I am wondering whether our schools are not beginning to teach the child the way in which it grows up, as the child first comes into knowledge of the things with which he lives. Now are we not teaching our geography very largely in the terms of the child's life? Do we not begin with the things that he knows most about, — about the hills and mountains, the brooks and rivers, the trees, — and gradually enlarge the child's mind until the last thing the child considers is the universe as an organization? I am wondering, after all, whether that is not the natural way? I thought when I left school that government was some far-off chimera, and that the only persons who had anything to do with the government were those who wore long, black coats and tall hats. Every child is in the midst of government, is he not, in the home and in the school? How many children know what the governmental apparatus of the school district is, and who the school officers are, and how they elect the school officers, and what their obligations are, and the term of office for the city, the county or the State?

I went to school and studied geology from a text book. I was told we could not study geology in the neighborhood of that school because there was none there; but once during the course of our geological studies we were taken some distance off on a train to see some outcropping of rocks, and when I got through, my idea of geology was stratified rocks. But now the teacher who teaches geology tells you that the earth's surface is a geological history, whether sand bank or rock-bottom stream; it all has gone through a change, as part of the earth's history. So the study of mere incidental outcroppings of rocks has ceased to-day to mean the study of geology. I am bringing these things before you merely to show that we are coming gradually to connect the environment with the child. Now we have put the child very largely in sympathy with its general environment, so far as geography is concerned, but we have not yet put the child in sympathy with the industrial forces of the community. We have not put the child in sympathy with the business of dairying, in a dairy centre; we have not put the child in sympathy with fruit growing, in a fruit-growing centre.

I was in an academy in New York State the other day. It is one hundred and twenty years old, and in the centre of it are a great many apples growing. And a new principal has come into that school. As I went into the school I saw the words "acetic acid," and I also saw the phrase "mother of vinegar," and I asked the principal what he was doing with this phrase on the board. He said: "Well, when the apple picking and the cider making were on, I talked with these children about the mother in vinegar, and in a very simple way of the process that was going on. And it was to those children as though information had dropped out of the heavens. Such information had never before been given in that school; and the children said, 'Why, that isn't the kind of teaching that a school ought to give.'"

Now, I would not have professional agriculture forced into the schools in any State, — not in the common elementary schools. I do not believe in making any elementary schools professional. I would not want to have medicine taught in the rural schools, nor theology, nor law. I would not want to have agriculture taught as a professional or technical business. We do not teach it so in our college of agriculture, where I am; that is to say, we do not say to the young men, "Come up here, — we are going to make you farmers;" but we do say, "Farm young men, come up and let us give you an education."

I would put this new type of education on a broader basis. Let those schools that need or choose to take it up, take it up; and I would not have it the privilege only of rural schools, but of all schools. If any school in any city wants to teach agriculture, I should be just as glad to have it taught there as in any school in the country.

In Illinois a large part of the schools in twenty-nine counties are teaching agriculture. The syllabus of the agricultural work in Illinois comprises something like thirteen pages, I think, in the general course of instruction. I am going to read you the reason why the Illinois people have put it in the school, and I want you to note it was not necessarily for the purpose of turning those schools into agricultural schools. The public schools should teach the fundamental principles of living, and let the young man or woman differentiate when they come to it.

First, to cultivate an interest in and instill a love and a respect for land. We are a nation of land owners. If we become largely a nation of land renters, then we change our social situation. An interest in land! Do not children have interest in ships? Do they not have interest in buildings? Why not interest in land as land, — the source of wealth and the occupation of agriculture?

Second, to create a regard for industry in general, and an appreciation of the material side of affairs of a highly civilized people, — industry of whatever kind it may be. The man who works at haying is a man that is creating wealth, as well as the man who is at the throttle of the engine.

Third, to cultivate the active and creative instincts. I wonder how the older ones of us were taught? We were given a book from which we memorized certain things, and told the teacher how much we memorized; then when we got up to college we were all given lectures, from which we recited back to the lecturer all that we could remember. I found, a few days ago, in going through some letters my father had received in 1851 from just over the line in Vermont, this little phrase from a school girl: "I sit myself expressly for the purpose to finish this letter, which has been long begun. I go to school to Mr. Wells, and study parsing, philosophy, grammar and pencilling." Does it not read like a phrase out of the old-time complete letter writer? And I am wondering how much the creative instincts of that child were developed. I had the opportunity one month ago of visiting with the child, or the woman who as a child wrote that letter, and talking with her about the growth of educational factors in that very town where she still lives, and it was a revelation as to the change of front in the schools.

Fourth, to give practice in failure and success. I like that word failure there, — to give practice in failure and success. Perhaps I should not quite say to give practice in failure, but to give the educational practice and discipline which comes from failure, thus developing the ability to overcome disaster early in life. I wonder whether one reason why the farmer boy becomes a forceful and strong character when he comes to the city is not because he has had lessons in failure, and possibly later in successful efforts he has overcome it? We have some fast crews at Cornell University, and we have been in the habit during the past few years of defeating other crews. This last year, however, we were defeated by our neighbor, the Syracuse University. Of course the young men felt blue. I said to some of them, who talked with me about it, that I was exceedingly glad they were defeated, — which did not increase my popularity with the students, — and for two reasons: first, that in intercollegiate sports one university should not take all the honors; and, in the second place, the discipline of defeat has an educational value. The value is in the discipline of the defeat. The farmer boy works under hard conditions many times, and perhaps he may fail; but, after all, he is guided by a kind mother and a strong father, who work for the strength of character and the honesty of purpose of the young man. And is not that one reason why the New England people have conquered the west as they have?

Fifth, to train the student in ways and methods of acquiring information for himself, and incidentally to acquaint him with the manner in which information was originally acquired and the world's stock of knowledge has been accumulated. Is it not the object of our schools to develop in the young man the power to store his mind with information? It is a very important part of education, which I do not wish to minimize; but, after all, the school must develop this power that he may acquire information for himself. A person wrote to me a while ago, "My ducks are dying; what shall I do with them?" I said, "Bury them." And then a farmer said, "The ends of my apple limbs are dying; what shall I do?" I said, "What are they dying with?" "I don't know," he said; "I want you to tell me." "Well, have you examined them?" "No, I just saw them from the barnyard." The farmer can never solve his own problems until he gets into the habit of acquiring information for himself, — see the things, and know what he sees. And the schools should develop that power. I do not care so much whether the training comes in merely what we call practical directions. I do not care whether the particular insect the school takes up is the potato bug, or an insect that has no such economic properties, if only he gets the power of arriving at the information first hand, — getting it for himself.

Sixth, to connect the school with real life, and to make the value and need of schooling the more apparent. Schools should not be exotic. The land grant colleges established on the proceeds of the land grant of 1862 have gone through a long experimental era, and I fear that for many years many of them did not connect themselves with real life except in a theoretical way. And the reason why these agricultural colleges are now growing so rapidly is because the people feel that they are articulating with the real problems of the people, and are getting hold of the real conditions in life.

Seventh, as an avenue of communication between the teacher and the pupil, it being a field in which the pupil will likely have a larger bulk of information than the teacher, — almost heresy! — but which the teacher can help to more exact knowledge. This is the question of co-operation between the teacher and the pupil.

I am wondering whether those categories do not impress you with the fact that is accepted by Superintendent Bayliss of Illinois, — that the agricultural work is not valuable, and is not put in the schools merely for the purpose of turning out farmers or for the purpose of developing special agricultural schools for such training? I more and more feel that this new type of teaching is never going to come so long as we have "rural" schools. I am wondering whether the rural school is not a passing institution? The country mill has largely ceased to exist. What the country mill did as a separate entirety or organization now may be done a good deal better, more economically, more quickly, as one small part of a larger organization in city or country. I am wondering whether the one-teacher country school is not a passing institution, and whether, if we were to differentiate our schools in order to take up different lines of work, the subject of consolidation of rural schools must not very largely precede it, in order that we may have stronger individual school units? The teacher in the school of one teacher teaches everything, from arithmetic to physiology and from algebra to history; and, although this person may be an excellent teacher, I am wondering whether or not her energies can be the most effectively engaged over such a very wide range of subjects? I do not care so much primarily whether the teacher has the special knowledge, as I do whether she is a good teacher, and has the enthusiasm and the point of view; but she cannot have the enthusiasm and point of view on all kinds of subjects. Our curriculums are overcrowded. How can we ever put any new studies in the elementary schools? That is the one objection to the agitation for agricultural subjects. I am going to read you the subjects that are taught in New York rural schools. I am sure you will agree with me that you would not wish to eliminate any one of those studies.

Reading? Certainly not. Writing? No. Spelling? Essential. English? Essential. Arithmetic? Essential. Geography? Essential.

Drawing? Yes. I look upon drawing not as a means of training young people to be artists, but as a means of developing self-expression. What do I speak for? Merely to express myself. I am making a very unsuccessful effort at the present time, but I am making the effort, — you see that it is laborious. Why do I write? To express my ideas in another way. Why do I draw with pen or pencil? To express my ideas. Now and then some child develops a particular knack for representing emotions and human ideas in pen and ink. That person may be an artist, as another by means of writing may become a litterateur, and another from speaking may become an orator. I think there are at least three fundamental modes of expression, — speech and writing and drawing; I think drawing is fundamental.

Not very long ago, in one of the teachers' institutes in New York State, which I attended, one of our teachers was speaking of drawing, and drew on the blackboard a very excellent picture of what she had seen a child draw not so very long since. You know about the picture, — there was a circle and two dots, and a line down the middle, then two lines towards the bottom and two at the side; that represented a man. The audience laughed when she said that was a good piece of work; and she said: "It is, because it represents that that child in the second grade had that idea of a man. He has arms and legs. Later on, the child will have an appreciation of clothing or of a hat, or something else." But we teach so much outside the child's realm!

Physiology? Perhaps. History? Yes.

Civil government? . Yes. I wish to comment on the words "civil government." In Europe this last summer I sought to find out what books they used in civil government. I did not find a school in which it was taught, — an elementary school. I went to book store after book store, asking for some simple book that would give me an idea of the fundamental principles of the government, and they said, "We don't know of any such book." And I said: "I know of one published in Boston, but I would like one published here. What do your children study in school?" "Why, they don't study those things; those are taken for granted." Of course every citizen in America is a potential president.

I wonder if the new points of view in regard to the one-teacher school I am talking about are not to come rather more by a change in the method of treating the subjects which are now there, than merely by forcing new subjects in? I wonder if this arithmetic cannot be expressed very largely in terms of rural problems? I wonder whether this reading, which runs from the first grade to the eighth, cannot be in part reading that has to do with country problems, quite as well as history and literature, — never cutting out history and literature entirely? Then, when it comes to the higher school, of course we can have our special courses of instruction. Many of the schools in the west are putting in agricultural courses at the present time. I am not sure that it is all going to stand or be permanent.

I am going to read you a course of study that is being taught in an academy in New York State, three miles from the New York line; this is the academy of which I spoke to you a moment ago. Here is an eighty-weeks course of agriculture, running over a period of two years; forty of these weeks are being taught this present winter. That is to say, the pupils who are in these courses of agriculture take nothing else; they are equivalent to the last two years of the high school. This year is being taught twenty weeks of soil, its cultivation and its composition, together with some experiments; also ten weeks on dairying, the types of dairy cows, the foods, the stables, the production of butter and cheese and the use of skim milk, — and the young men expect to utilize as a laboratory the creamery in their town; and ten weeks of seed, grass and fertility. That is the instruction that is being given this year. I do not commend it, necessarily, but only state it as an illustration that something is being done in New York State. The next will be ten weeks on orchards, ten weeks on farm buildings, and twenty weeks on poultry, beef cattle, hogs, sheep and horses.

We have also in New York State an academy which has an endowed department of agriculture, — the only endowed department of its kind in the State, as far as I know, in the public schools. It has a four-years course of agriculture, and there are four terms in the year, running through the sixteen quarters. In the first year the agriculture is geology and farm buildings; the other subjects are English, arithmetic, physical geography, drawing and the like. The second year the agriculture is in the form of zoölogy, entomology, dairy husbandry, horticulture, soils and fertilizers, poultry keeping, physics as relating to agriculture, and certain other subjects.

Now, the difficulty with us in New York State is that our State syllabus does not include such subjects as these; so that, while these subjects may be introduced in the schools, at the same time they are gratuitous and supplementary. I think there will be great change soon in that regard. I should not like, as I said before, to see any agriculture forced into any school by mere law. I would like to see the opportunity given whereby nature-study would be taught up to the fifth and sixth grade, we will say; then let it go into those schools, city or country, that desire to take it up under equal conditions with any other subject in those schools; and then let the process of evolution do the rest. And I should hope that these subjects would be discussed, and intimately, by the agricultural people of the State.

One other subject I would speak about, and that is, the question as to whether or not we shall have separate schools for the instruction in agriculture. Upon that question I am not going to express any decided opinion at the present time, although I have some opinions. I think that question is of secondary consideration. I think the first consideration is that the schools of the Commonwealth should be open to agriculture and nature-study, such as I suggest, on equality with other subjects; and then, after that transpires, if it is thought to be desirable to have certain special schools to teach agriculture, that question can come up for special consideration. But I should be very sorry to have any popular demand in the eastern States whereby all agricultural instruction would be relegated to special schools, and not be put on a parity with the other instruction of the common schools. In other words, I do not believe in putting all the agricultural students off by themselves, and putting tags in their ears. I would want them to feel that they have the same opportunity in the public schools that other children have in other studies. Then the time may come, and very possibly will, when for more special training in certain regions we may need supplementary institutions, in which agriculture and domestic science and some other studies are taught.

These, then, are, in a very brief and imperfect way, some of my own opinions and points of view in regard to the study of agriculture in our schools; and I wish to say, in closing, that the subject is on for discussion, and any indifference on the part of school teachers or indifference on the part of farmers cannot stop the discussion, — it is in the air. A few of the States have adopted text books; whether that is wise or not, I am not going to say. Some of them have enacted laws compelling the teachers who seek certificates for certain grades to pass examinations in agriculture;

whether that is wise or not, I am not going to say. Of all the subjects that are now before the farmers in the country, I believe those that are uniformly awakening the most interest are the ones that have to do with questions of education; because the farmer has come to think that, unless he has the same intellectual opportunities that any other man has in the community, he cannot hold his own. In other words, agriculture is put upon an intellectual plane; and the young people must feel that the school and all the interests that make for better country life recognize the importance of the agricultural affairs in the same way that they recognize the importance of any other subject that makes for the weal and the welfare of the nation.

The CHAIR. This subject is now open for discussion, and we shall be glad to hear from any one who feels like taking part in it.

Mr. B. P. WARE (of Marblehead). You all know that it has become a fad for public speakers on agriculture to encourage the introduction of agriculture in our common schools as a remedy or answer to the question, What shall we do to keep our boys upon the farm? I have never felt in sympathy with this fad, because, in the first place, it is impractical. Agriculture is too broad a subject to be handled by our children; it opens a field for the practical application of all of our natural sciences. Yet, while we should not introduce agriculture as such in our common schools, our reading books, our arithmetic examples, might have an agricultural tendency. I do approve of the introduction of nature-study, teaching nature's laws. This may be made very simple and exceedingly interesting to children. The lecturer spoke of the importance of the different methods of education. He spoke of drawing as an important study in our schools. I am aware that many feel that it is only for the idea of developing artists, but he tells us, and I know from my own experience, that it is a valuable method of expression.

Prof. F. A. WAUGH (of Amherst). In the State of Kansas the superintendent of instructors goes about from school to school to see how the schools are getting along. He went into a country school one day, and seeing the word "average" on the board, asked, "What is an average?" They didn't know. Finally one boy put up his hand to signify he knew, and when asked, replied, "An average is what a hen lays an egg on." As there seemed to be a good deal of surprise aroused at that, the boy said, "I can show it to you in the book," and he turned to a page and pointed to the sentence, "A hen lays three eggs a week, on an average."

Now, there was a problem expressed in agricultural terms, —just exactly what Professor Bailey has been pleading for, and it accomplished exactly the opposite result. I didn't bring it up because it was a famous case, but because it does give point to the consideration that, if the study of agriculture in our schools is to be a mere matter of memory, it is of no more value in the public school than anything else; and if it is a question of simply putting things in agricultural terms, we have not accomplished anything at all.

He spoke of the spirit which the school must maintain, which is a much greater thing. He said what appeals to me much more strongly, that there is no need of forcing agriculture into the schools, and he doesn't believe in it. I don't believe in it. But there is one aspect of this question which I think can be believed, and that is, the pedagogical value of agriculture, — its teaching value, the educational value of it. You know some other subjects are put into the curriculum partly on that account. There is a gentleman here this morning who is very much interested in this matter, and he ought to be arguing this, instead of myself. He tells me they had actually forced Latin into the eighth and ninth grades of the schools in his section. And why? For two reasons, one that was given and the other a reason that was operative. Both, I believe, had some influence; but the reason given was that the teaching of Latin had a very great educational value and the other was that the pupils could get along so they could go to Harvard soon. I think these things train the mind just exactly as much as Latin, and a good deal more. A man catches a toad and explains what the toad is doing and about his habits of life, and that means something to the youngster. He thinks about it, and that is the main thing; it fills his mind with ideas. And, after all, ideas are the basis of education.

I think we can test this matter. I have seen men who graduated from colleges in different parts of the country; I have seen graduates of agricultural colleges. Of course you won't expect me to say anything but that the agricultural boys are a long ways in the lead, but I say it because I believe it, most emphatically. And it is because they see things they can understand, and it awakens ideas in their minds. I have had numerous opportunities to see these young men come into contact and competition with each other in a business way, and, while it is very hard to strike an average in such things, it has always seemed to me that the boys who were trained by coming into contact with things they understood have the preference. They are better educated men when they get through than if they took the classical education. I don't want to speak slightingly of the classical education, because I think it was a good thing —a hundred years ago. I speak as I do because these things give an education. They are the best sort of things to train the man, to train the mind. So I think we would have a certain justification in putting agriculture in the common schools, because it trains the mind, and not for a mere sentimental purpose.

Mr. S. H. Reed (of West Brookfield). I would like to speak a good word for the public school teacher. I see evidences all along, here and there, in Massachusetts, that there are scattered about teachers interesting their pupils in nature study. They commence with the birds, and then take the flowers and plants. I know when one of my daughters was in school the scholars were all anticipating spring, so they could take up nature study again. I had some friends down in Virginia, and wrote to them, asking them to collect twenty-five varieties of flowers, with their branches, that were in blossom at that time, which was in March. They gathered them, and soon after they were taken to that school, and the children commenced about four weeks ahead of time that year.

This thing has been carried along in other lines. I saw a collection made by a boy of all the different kinds of wood that grow in this section. Now, there are many of us who go out driving and take our children, and teach them so they can name every tree by its bark and leaves; and there are many teachers who follow along these lines, too. I was very much interested lately in a little incident. We had a very successful teacher, country bred, who asked each scholar to collect various objects showing the products of our country, — mineral, and so on. My boy selected the agricultural objects, and I was enabled to help him by the agricultural bulletins that come to us so freely. He included cattle, sheep, hogs and the cereals; and the footing was something enormous. And when it was read in school, with the mineral and other products of the manufacturer and so on, in the United States, the teacher thanked the boy, saying that that was valuable information; and it was shown clearly to the school that the farmer has his place in the United States, and ought to be recognized.

I want to ask the speaker one question. Hasn't the time come now when it is generally recognized that scholars in agriculture as well as the sciences can hold their own, in liberal education, with those who take a simple economic course?

Professor BAILEY. I think, sir, in answer to your question, I shall have to express an opinion. I believe thoroughly with Professor Waugh that these men who have had an agricultural education are just as well-educated men, as measured by the ability they have to handle their own affairs, as measured by the breadth of their horizon, as the men who have received an economic training. I don't believe that our agricultural work in the boys has always been of equal pedagogical value, — perhaps it isn't at the present day; but I think on the average it is. And certainly the methods of handling agricultural subjects, as they are now handled in all the best agricultural colleges, will train a man's mind as effectively, will give him as intimate a hold on life and as broad a reach, as anything else that could be put into the school.

Mr. J. T. CORLEW (of Wayland). I would like to thank Professor Bailey for the suggestions that he made along the lines of geography and arithmetic, especially that idea of substitution of arithmetic, taking out some of those subjects that have been dead and buried for the last fifty years, and putting in their places live issues. And it seems to me that he could have gone a little further, and used the term "elimination," for the demands of arithmetic for to-day are not the demands of arithmetic of fifty years ago. To-day we are teaching in our schools two kinds of arithmetic, — mental arithmetic and detrimental arithmetic; and we are teaching about four detrimentals to one mental. I mean we are teaching a lot of stuff that hasn't any practical value; and if we could eliminate it, and do what Professor Bailey said, substitute for the dead arithmetic a live arithmetic, we would have more time for nature study. We would have more time to look at the great book "out doors," which we shut out from the life of the child by a dead world of books. Books are all right in their place, but there is a big book out doors that has all the elements in it for any kind of an education, whether it be arithmetic, language or what.

Mr. POTTER. I would like to ask Professor Bailey his opinion of the results obtained in one country in Europe, as he observed them. I have understood, from reading and otherwise, that in Holland agriculture is taught in the public schools, and that every teacher who applies for a position has to be examined and pass an examination showing that he is competent to teach agriculture as well as other branches of learning. I have also understood that in the theological colleges agriculture is taught, in order that the graduate, when he becomes a pastor, may be fitted to teach his parishioners the elements of agriculture. Now, if that is so, we have one country in the world which is perhaps better educated in agriculture than any other, and the farmers have control of things, and are in many cases graduates of colleges. As a result of this education, the production of a cow in Holland averages three times the production of a cow in this country. And we also find that that country sustains a population four times as dense as it is in Massachusetts.

Everybody seems to have enough to do, and enough to eat. I would like to ask Professor Bailey if he has observed on the ground any of these things, and, if true, why is it not a good argument in favor of teaching the elements of agriculture in our common schools?

Professor Bailey. It is a very difficult question, — in fact, an exceedingly difficult question. I have given some attention to the condition of agricultural teaching in some of the public schools in Europe, never specifically in Holland, although I have visited the country two or three times. I have, however, in Germany. There they do give a great deal more instruction in the common schools on the lines of agriculture than we do. The instruction they receive in the common schools is ordinarily first class, and puts the pupil in touch with the real problems existing there, to a large extent; but one difficulty is, that the effect of that is very largely minimized by the social condition of the country, particularly if the pupils belong to the peasant class. One reason, in my opinion, why the agricultural production is so much greater in the old world, is because of the fact that the population is so dense that the mere struggle for existence compels it. That is partly a social and largely an economic question, and not wholly a pedagogical one.

Much has been said of teaching agriculture in the schools of France and Germany, and even in the schools of Austria, also in Denmark. We are a long way behind the European nations in agricultural instruction. We have no schools in this country where one can go and learn merely husbandry or the pruning of fruit trees, and there are such schools in the old world; they are a special branch of work.

I don't wish to be misunderstood about advising the introduction of agriculture in our schools, — I do believe in the introduction of subjects of that kind; but my point is, I do not believe in forcing them in, and teaching them as professional subjects. I should like to have the opportunity of developing them in a normal and natural way, as other subjects are developed in our schools.

Mr. F. A. Bliss. I came here to-day almost on purpose to hear Professor Bailey's address, because I have found in my own community there is a most decided mind upon the part of the people that some phase of agriculture should be taught in the schools. I attended an open meeting in one of our granges two weeks ago, and the superintendent of schools in the town of Attleborough was the gentleman who gave the address. His subject was the subject we are talking about to-day. He showed that he was very much interested in the introduction of agriculture in the schools, and had tried to carry it out this last year. After his address several statements were made by practical farmers in the audience. He then arose and made this statement, that the great obstacle in the way of introducing agriculture into our schools was the fact that the teachers were not prepared to teach it, from the superintendent down. I have talked with a good many teachers in regard to this matter, and they all told me they would like to teach it, and would be interested in it, but they were not prepared to teach it.

There seems to me to be one special reason why it should be taught. There is a changed condition in our schools from fifty years ago. I have a school in mind, — it is a school that my daughter is teaching. She has twenty-nine pupils, twenty-five of whom are foreigners, mostly Portuguese. There is a Portuguese settlement near by. Those Portuguese children will attend the school, the grammar grades, perhaps, just a few years; nine-tenths of them will then be compelled to earn a livelihood. It seems to me that the successful man is a better citizen than an unsuccessful one; and it seems clear to me that, if those Portuguese children could be taught the simple elements of agriculture, so that they would know more than the average farmer knows to-day in regard to the conditions of the soil, in regard to plant food and a hundred other simple things, they would be very much better citizens than if they grow up in ignorance. They can study in these schools the rivers and mountains of Alaska, and will forget them in twenty-four hours; but going to school from the little farm where their parents are tilling the soil, they will be interested, and doubly interested, in the subjects of agriculture, if they are taught in the school.

Dr. H. H. **Goodell** (president Massachusetts Agricultural College). There are two points that I want to speak of, and just for a moment. One is the influence of the parent upon the child. If you had been in my place, and had heard, not once but time and time again, ladies who brought their sons to college say, "I don't wish my son to become a farmer; it is too hard work, and I wouldn't wish for any one, a son or daughter, to take it up for a profession," you would understand what that means.

The other point is in reference to colleges. I believe there is a field for our college, and not simply for the young men who go there, but, I am happy to say, for the young women who are going there. As yet no woman has graduated, but at the close of this next year there will be two go out, and later on others. I hope that some of them will take up for their profession that of teaching. I think they will be not only fitted, but well fitted, to give instruction on this very line.

There is one thing that I should regret very much, and that is, the forcing of this education in agriculture into the elementary schools. I believe that we must grow up to it. I don't believe as yet that the schools are ripe for it. If this thing is forced in, and the teachers are compelled to take up a subject about which they know nothing, it will be simply distasteful work to them, and they will not teach it with the enthusiasm that they do other matters and other subjects; and, being in that position, they will inevitably fall into the same error in which I did. I had been teaching perhaps ten years, and I had a very bright class, with of course the usual exceptions, as you will see. I had the subject of the Crusades, and took it up at length. I think I discussed it for five or six days, and then had an examination with the class, and they did fairly well. But about three days afterwards I met my Waterloo. I was going down town, and one of the members of the class asked me if he could have the privilege of walking down and talking with me. I said, "Most certainly," and he said, "Now, Professor, there is one question I want to ask you; perhaps you will think it a little strange, but, hang it all, what is a Crusade, anyhow?"

Dr. W. H. **Jordan** (Geneva, N. Y.). We have from the first prejudiced our case with educators and with a large portion of the public by the application of a class name to knowledge and education that has the broadest application. What we wish to do is to teach the boys and girls their relation to themselves, to their environment, and to give them power of momentum in particular directions. In teaching the sons and daughters of rural people, we are teaching those who will be farmers, physicians, merchants, lawyers, statesmen and even politicians, and we want to bring them in touch with life. When you have brought a boy in touch with life, so that he sees dignity in common things, then you have given him a momentum over the farm, if that is where he belongs, and you have given him a momentum possibly in other directions.

Mr. **Henry Whittemore** (State Normal School, Framingham). I want to enter very heartily into sympathy with what Professor Bailey has said. If we people who have control of education should take all the things that people want us to in the public schools, there wouldn't be anything left of the public schools. There is one thing I am very sorry to see, and that is, the almost utter ignorance of the farmers of the common school and what it is doing. We are teaching all phases of agriculture, as I understand it, in the common schools of Massachusetts. We have voluntarily entered into all the questions of analysis of soil, the discussion of seeds, the healthy and unhealthy plants, animals that are good for the farmer, and those things that help to make good crops, — all those things. We are fighting for the school gardens, which is the beginning of teaching, not only on the question of agriculture, but going back to the great economic question of correct living in towns of this size and towns of a larger size. We are all in sympathy, Mr. Chairman, with this question of teaching agriculture.

It seems to me that education should have some breadth to it. No institution should look simply at one point of view, whether it is the work on the farm or in the machine shop. There is a breadth of view that we people who have charge of schools attempt to include in our schools for these daughters of yours who come to us for education. There isn't any reason why we shouldn't teach all those problems of arithmetic, and they are taught. If you will look at the arithmetic that is taught in the schools to-day, you will find that there is a wonderful breadth to it, and the breadth has come from the city of New York and from the city man. It is the application of all the things in life that will teach the young man that his life, wherever he is, is worth living for the best, whether it be in agriculture or whether it is in a town or city. The school teachers are wide awake to it; I don't know anything about the farmers.

The CHAIR. I am sorry that we haven't more time for discussion, but the hour for adjournment has arrived.

Adjourned.

AFTERNOON SESSION.

The afternoon session was called to order at 2 o'clock by Secretary Ellsworth, who introduced Mr. Warren C. Jewett of Worcester as the presiding officer.

The CHAIR. This forenoon we heard one of the best of lectures on education in agriculture. None of us, perhaps, feels the need of such education more than those who were deprived of it in their early days, and who have had to educate themselves up to the farm work that they are carrying on. To my mind there is nothing that gives those of us who have not had the advantage of education more assistance than the experiment stations. They have done more than anything else in helping me to feed my cattle to a profit. It is with great pleasure, therefore, that I introduce to you at this time Dr. W. H. Jordan, director of the New York Agricultural Experiment Station.

PRESENT DEFINITIONS OF SOIL FERTILITY.

BY DR. W. H. JORDAN, GENEVA, N. Y

Soil fertility is a subject of vast economic importance. It is a trite saying, now so obviously true as to need no argument, that soil resources are the fundamental resources of our material prosperity. Our fruit, stock and dairy interests are the agricultural superstructure of which the producing power of the soil is the foundation. Because these things are true, dire prophecies of disaster have been uttered concerning that nation the productivity of whose fields should have become weakened. Doubtless you all recall the jeremiad of Professor Crookes, in his address in 1898 as president of the British Association, in which he prophesied that in 1931 the wheat supply of the world would fall below the real need of the human family, because of the lack of available soil nitrogen. While Professor Crookes' conclusions seemed to many to be based upon insufficient and incorrect premises, these utterances show the solicitude with which thoughtful men regard problems of soil fertility in their relation to human welfare.

Perhaps you wonder why I have selected this theme for to-day. My reason is that, while the subject is certainly old, we seem to be constantly viewing it from new and interesting points of view. I am quite sure that no well-informed man would now discuss soil fertility from the same standpoint from which he viewed it fifty, twenty-five or even ten years ago. It may be well to say, as a cheering anticipation of what is to follow, that it is not so easy to be a prophet of evil now as it was at one time. He who would now place the future subsistence of the race on so precarious and gloomy a basis as has sometimes been presented to us, might fairly be charged with indifference to, or ignorance of, the more recent developments of science.

When I first began the study of agricultural science, soil fertility was discussed chiefly on a mathematical basis, and the maintenance of fertility was set forth, at least in a popular way, largely as a matter of book-keeping. Let us see how this came about. Our knowledge of plant nutrition, even in its most popular form, had its beginnings in the researches of pure science. The real first teachers of agricultural principles were not hard-handed tillers of the soil, but such toilers as DeSaussure, Boussingault, Liebig, Way, Knop, Hellriegel and others, who, in their laboratories, animated solely by a love of truth and without thought of material recompense, searched out nature's secrets. What did they learn? They learned, first of all, what are the constituents of the air, soil and plants; they determined the relation of the plant to its environment of soil and air; the sources from which plants draw their food; and the elements which are absolutely necessary to the building of the plant. In the unfolding of this knowledge it was discovered that the greater portion of the dry substance of a plant is drawn from the atmosphere; but that certain ingredients, especially those which we speak of as the mineral part of the plant, must come from the soil. Moreover, it appeared, from the investigations made as to the composition of plants, that ten or more elements are uniformly found in all plants, though in varying proportions, but that the fruit or seed of a particular species has a reasonably constant composition. It was also made very evident that a few of the essential mineral constituents of plant growth exist in soils in very small proportions, and that these constituents are constantly subject to waste through the processes of agriculture. More than this, it was found, in practical agriculture, that when certain compounds containing essential elements of plant food were added to the soil, in many instances a large increase of crop followed. By all this knowledge, laboriously wrought out, certain premises seemingly indisputable appeared to be established, and pointed to what was regarded as a sound conclusion. The reasoning may fairly be stated to be something like the following: plants contain certain elements, some of which are indispensable to their growth; certain of these indispensable elements are contained in soils only in very small proportions, and when compounds containing these elements are added to the soil, a marked increase of crop often occurs; consequently, a low productive power of the soil is due to the absence below sufficient quantities of certain elements of plant growth. This is the syllogism which was placed before my mind as a student of agricultural chemistry nearly thirty years ago, and it forms the basis of what farmers have ever since been taught to be a chief consideration in the maintenance of the fertility of their farms.

Let us glance at what are some of the results that have proceeded from this point of view. The chief result is what I have designated above as the discussion of fertility on a mathematical basis. This discussion is very largely centred around tables showing the average amounts of nitrogen, phosphoric acid and potash contained in our farm crops. We have pointed to these tables, and told the farmer that, for instance, a crop of two hundred bushels of potatoes removes from his soil so many pounds of nitrogen, phosphoric acid and potash; and that, when the crop is sold, his farm is thereby so much the poorer in the essential elements of fertility. The farmer has been assured that he need not trouble about other elements, because his soil contains them in abundance, and will always continue to do so. A natural and inevitable conclusion from such premises has been, that the way to maintain the fertility of the soil is either to adopt such a system of farming and such care of manurial residues as would prevent loss from the farm of the peculiarly valuable elements of fertility, or to purchase and return to the soil an equivalent of the nitrogen, phosphoric acid and potash which is sold in crops or other products. I do not assert that other factors in fertility have not been more or less discussed, but I am sure I am correct in saying that the considerations as I have outlined them are those to which the farmers' attention has chiefly been drawn.

Again, it is not too much to say, and I think you will agree with this, that the commercial fertilizer trade originated in, and has been nourished by, this one-time attitude of the scientific world toward the maintenance of fertility. What a magnitude this trade has reached! The farmers of the country are now paying annually more than fifty millions of dollars for commercial fertilizers. In 1899 the average cost per farm in Massachusetts for commercial fertilizers was $35 per farm, or $1,320,600 for the whole State. The manufacture of fertilizers is one of our greatest industries. We have searched up and down the earth and have entered its very bowels, and we have carefully scrutinized every waste product of our great manufactures, in order to provide raw materials for this constantly increasing traffic. The search has been for the compounds of nitrogen, phosphoric acid and potash, and the prices of the manufactured mixtures are based upon what they contain of these three ingredients; thus placing tremendous emphasis upon the point of view that the chief requirement for the maintenance of soil fertility is to supply to the soil, artificially or otherwise, three of the ten or more required constituents of plant growth. It is indisputably true, I would reiterate, that at one time our attention in commerce and in practice was so fixed upon this general conception of soil exhaustion and fertility that all other considerations were almost entirely ignored, at least in popular discussions.

It must be confessed that just now there is going on a readjustment of the definitions of fertility, and, as is generally the case in such periods of progress in knowledge, it is accompanied by more or less confusion of thought. It must be confessed that fertility and its maintenance are not so simple in their relations as they would appear to be on the basis of keeping books with the soil.

In order to understand some of the changes which are now taking place in our point of view, we must refer to a division of knowledge which to quite an extent stands apart from the chemistry of plant nutrition, viz., soil physics. This field of agricultural science relates to soil conditions rather than to soil composition. It deals with soil texture, soil aeration, soil temperatures and the supply and movements of soil moisture, — factors which are found to have controlling relations to plant growth, and whose importance is clearly seen by noting some of the causes which determine the yield of crops on different soils and in different seasons.

One of the facts most commonly observed is the variation on the same soil of the yield of crops in different seasons, even though the treatment of the soil does not vary from season to season in any essential particular. The most apparent cause for this uneven production is the variation in the times and quantity of the rainfall. A deficiency of water supply at certain critical periods in the life of the plant is disastrous to its welfare. Of course this is so, you say, because water is plant food as truly as is potash. Certainly it is, but it sustains such essential relations to the full utilization of other forms of plant food that it possesses an importance different from, and entirely apart from, the mere matter of a ledger account with the soil elements.

Certain soils, regarded as barren when cultivated in the ordinary way for field crops, have, to my personal knowledge, produced surprising crops without being fertilized, when used in a forcing house where the water supply and temperature were made as favorable as possible. The ordinary explanation of the sterility of such soils has been that they are deficient in the mineral elements of plant growth, — a supposed explanation which fails to fully explain.

Consider for a moment a striking illustration, so familiar to us all, of two adjacent farms of greatly unlike crop-producing capacity. The soil of these farms was originally entirely similar. Not unlikely the pounds of nitrogen, phosphoric acid and potash withdrawn from one farm have been as many as those taken from the other, but the soil management has been different. One farm has received organic, the other commercial, manures. The systems of rotation of crops have differed in the two cases, so that the amount of organic matter introduced into the soil has been much greater for one farm, thus causing a superior condition of texture. Tillage has been more thorough for the better farm, thus favorably modifying its soil conditions. In short, the explanation of the advance of one farm and of the retrogression of the other is to be found in the maintenance of, or failure to maintain, certain soil conditions, rather than in an inspection of the debit and credit account with certain soil elements. This picture is a true representation of conditions frequently seen.

There is other knowledge of more or less recent development which cannot be ignored in reaching the best understanding now possible concerning soil economics. Generalizations so common in the past regarding plant nutrition and soil exhaustion have, in my opinion, too fully ignored the wide variations in the compositions of plants. Recent experiments at the New York Agricultural Experiment Station, not yet published, appear to me to place renewed emphasis upon the fact that there are not yet ascertained fixed amounts of the essential constituents of plants which constitute the minimum requirement. I have found that, when the supply of potash varies in the soil, one plant may attain what is apparently a maximum development with 100 to 200 per cent less content of potash than is found in another plant of no larger growth. This has proved true in the case of tomatoes, tobacco, peas, rape, and to a less degree with barley. Similar results, though not so emphatic, were secured touching the relations of phosphoric acid to the dry matter produced.

As an illustration of the wide variation in the figures given for the quantities of ingredients withdrawn from the soil by crops may be mentioned the large differences between the German and American tables. According to the averages which represent the composition of American-grown potatoes, a crop of 300 bushels would withdraw from the soil 12½ pounds of phosphoric acid and 52 pounds of potash. Similar calculations based upon the averages of German tables would show a use of 25 pounds of phosphoric acid and 81 pounds of potash. The German figures call for twice as much phosphoric acid and approximately 56 per cent more potash than the American. On the other hand, figures for sugar beets show exactly opposite relations. From estimations by the American tables we learn that 15 tons of sugar beets will utilize in growth 30 pounds of phosphoric acid and 124 pounds of potash; but if we adopt German averages as a basis of calculation, the quantities would be 18 pounds of phosphoric acid and 78 pounds of potash. It would not be strange if the practitioner, supposing that he must adapt his fertilizer to the composition of his crop, becomes confused in the midst of such discrepancies. All this goes to show that the mathematical method of discussing fertility, even if it was rational in all other respects, must be regarded as subject to great inaccuracies, when applied to a particular season or locality.

The fact is, that season, environment and methods of manuring the soil materially affect the composition of the plant. A striking illustration of this may be found in the figures obtained on the station farm in an experiment to test methods of maintaining soil fertility. In 1897 and 1898 careful determinations were made of the average composition of the entire corn plant, covering a crop on 12 acres in each case. The percentages of nitrogen, phosphoric acid and potash in the dry matter of the crop of these two seasons were as follows: —

	1897.	1898.
	Per Cent.	Per Cent.
Nitrogen, ...	1.00	1.27
Phosphoric acid, ...	.31	.48
Potash, ...	.97	.80

The growth of 1897 contained in a unit of dry matter 20 per cent more potash than the crop of 1898, while the dry matter of the crop of 1898 had a phosphoric acid content 55 per cent greater than the crop of 1897. In the light of these figures, the adaptation of fertilizers to the composition of crops, as shown by average percentages, seems to be a precarious undertaking.

In order to compass the factors which relate to soil fertility as we understand it to-day, we must step outside of the domain of chemistry, and enter the domain of biology. It is one of the greatest triumphs of science that we have come to understand the profound and practically important relation which certain microscopic forms of life inhabiting the soil sustain to the fertility of our fields, — a relation which has a vast significance to the human family. These organisms are minute, — too minute to be seen by the unaided vision; but in a silent and unseen way they appear to do a work which is second to none in its importance to the farmer. For the purposes of a brief discussion I shall classify these organisms according to function: —

1. Those which cause chemical changes in the nitrogenous constituents of the soil, both inorganic and organic.

2. Those bacteria which, when associated with certain agricultural plants, in some mysterious way through this symbiotic relation confer the power upon these plants to acquire atmospheric nitrogen.

3. Those organisms which, when not sustaining, so far as is known, any relation to agricultural plants, cause the soil to acquire nitrogen from the atmosphere.

Speaking with regard to the first class of organisms, permit me to state that their existence and office have been known to us for some time. These are the forms of life which perform the valuable and necessary service of causing the otherwise useless organic nitrogen to change to the form of nitrous or nitric acid, through what we know as an oxidizing process; or which accomplish the reverse process, and by deoxidation split up the oxides of nitrogen and cause a loss of nitrogen from the soil.

It must be confessed that our knowledge of these classes of bacteria is very incomplete; but it is fair to reason from known facts that a well-drained, well-aerated soil promotes the favorable or nitrifying process, and that an undrained, non-aerated soil, especially when heavily loaded with organic matter, supplies the conditions for the unfavorable or denitrifying process. More than this we cannot say concerning the farmer's ability to determine which process shall go on in his soil.

When we come to treat of those bacteria which associate themselves with the leguminous plants, such as alfalfa, clover, beans, peas and so on, we enter a field of knowledge which has been productive of valuable practical results. In order to illustrate what I mean by this statement, allow me to refer to alfalfa, a crop which has come to sustain an increasing importance to the agriculture of New York, as well as to that of many other States. If you were to step into the alfalfa field of the New York Agricultural Experiment Station, and dig up the root system of a single plant, you would find attached to the roots small round bodies called nodules, which are characteristic not only of this plant but of all other species of the leguminous family. It has been found to be true that, when the roots of alfalfa plants or other legumes grow in a medium devoid of certain minute organisms, these nodules do not form, and the plants often do not prosper; and that the introduction of the organism into such a medium causes the nodules to develop in great abundance, with a corresponding improvement in the color and growth of the alfalfa or other leguminous plants. The presence, then, of these bodies on the roots of the legumes is a sure indication as to whether the soil in which the plant is growing is inhabited by the organisms which somehow associate themselves with the plant, and impart to it the power to take up atmospheric nitrogen. It appears to be true, as shown by attempts to introduce alfalfa widely throughout certain States, that some soils are not fitted for the production of alfalfa, apparently in some instances because they are not charged with the organisms which maintain an existence in connection with the alfalfa plant. Through a process of reasoning which certainly is quite obvious, there has arisen, in the State of New York at least, a practice known as soil inoculation. The cheap and practical way of doing this is by transferring to a field on which it is desired to grow alfalfa for the first time a quantity of soil from some other field where alfalfa has maintained a successful existence. You ask if beneficial results have followed from this practice. Not always, but decidedly so in some cases. For instance, the New York Agricultural Experiment Station has this year conducted some experiments on the light soils of Long Island. Alfalfa has been sown with no application of any kind, with the application of lime alone, and with the application of both lime and soil from the alfalfa fields on the experiment station farm. I should explain that the reason for using lime is the old and somewhat persistent view that the bacteria which associate themselves with the legumes require a soil with a neutral or slightly alkaline reaction, rather than one with an acid reaction, the latter condition being considered unfavorable for their development. The results of our observations for the season of 1904 are that the application of the alfalfa soil from our alfalfa fields has greatly promoted the welfare of the plants growing on Long Island, but the benefits of lime are not so evident. These observations are ratified by similar ones in other parts of the State and in other States; while, on the other hand, certain experiments show no advantage from soil inoculation, the plants prospering on the experimental field without any application whatever.

The relation of these facts to fertility problems I understand to be the following: —

It has been clearly shown, I think, that leguminous plants, when not supplied with sufficient available soil nitrogen for full development, and when properly associated with certain minute forms of life, have the power of utilizing atmospheric nitrogen. This nitrogen, when stored in the plant, becomes available to subsequent cereal crops either through the manure heap or through the decomposition of the leguminous roots in the soil. We have here a factor in fertility which, to my mind, has received too little consideration at the hands of such scientific prophets as Professor Crookes. I am hopeful that the alfalfa fields of New York will prove to be an important factor in maintaining soil fertility on the nitrogen side.

Just at this point permit me to suggest a caution in our positive utterances. Much of the teaching from the institute platform, and possibly even the utterances of our colleges and experiment stations, has allowed the inference that *all* the nitrogen taken up by a leguminous crop, alfalfa, clover or otherwise, is withdrawn from the atmosphere rather than from the soil; and that the nitrogen found in this crop is wholly additional to the stock of nitrogen which the soil contained before the crop was grown. We have no proof of this, and any statements in this direction are pure assumptions. All we have learned definitely is, that under certain conditions leguminous plants have the capacity for taking up atmospheric nitrogen; but when the soil is fairly well supplied with available nitrogenous compounds, we do not know to what extent the legume will utilize the nitrogen of the air. We have observed this, however: that, when a field of alfalfa is properly supplied with phosphatic and potash manures, it will continue to produce abundant crops through a long series of years, without the addition of any nitrogenous fertilizers whatever. This has been illustrated beyond question on the farm of the New York Agricultural Experiment Station. I wish it were possible for the alfalfa plant to become extensively used in the State of Massachusetts. To what extent your conditions are adapted to the growth of this valuable forage crop I do not know.

When we come to consider the question of bacterial organisms, not associated with the plants of the leguminous family, but which we have good reason to believe may cause the fixation of atmospheric nitrogen in the soil, we are, it must be confessed, in the field of theory so far as practical results are concerned. Professor Burrill of Illinois, who is an expert in the field of bacteriology, makes the following statement in a recent paper: "After many tests upon numerous self-inhabiting species, certain kinds of bacteria have been found which undoubtedly have the power of building the aerial nitrogen into combinations which subsequently serve as food for the higher plants." Professor Burrill subsequently states that the amount of nitrogen thus fixed is small, and that experiments with an artificially prepared substance, called alinit, which is a pure culture of one species of bacteria, have not shown any considerable increase in crops, although favorable reports have been received in some instances.

But such researches as these open up an outlook upon great possibilities. When we remember that some of our soils are probably very generally supplied with countless millions of these bacteria, and that there is some reason for believing that they are the media through which the nitrogen of the air is to some extent transferred to the available plant food compounds of the soil, we are inclined to turn aside from the pessimistic prophecy of future limitations of our food supply, to the more optimistic view that man is too creative and has too large resources at his command to ever find himself limited in the means of sustenance. Certainly such a hopeful view receives some support from the fact that so many of our soils which have been subject to the devastations of improvident farming have so long retained their power to produce fairly luxuriant crops. I am sure it has occurred to every thinking man that nature must, in some way not yet fully explained, be defending herself against man's wasteful methods.

There is especial need, however, that we should hold ourselves in reserve concerning certain phases of the soil bacteria discussion. I greatly fear that on the part of some popular writers hypothesis is being projected into fact, and that from certain data wholly unjustifiable inferences are being deduced, — a danger which constantly assails us, and from which we have suffered all along the line of the progress of agricultural science. Doubtless some of you have read an article entitled "Inoculating the ground," in the October number of the "Century Magazine." Such a presentation of a new line of research is to be deplored. It reacts against the welfare of science, and, it seems to me, ought to be regarded by the distinguished scientists whose work is discussed as most unfortunate. In the first place, the discussion apparently proceeds from the point of view that fertility depends solely upon the supply of nitrogen to crops, and that when the nitrogen problem is solved we have nothing more to fear in our efforts to feed the human family, — a most unwarranted position. In the second place, these bacteria are pictured as remedying all soil defects and as being an open sesame to agricultural prosperity and generous farm profits. Listen to the following statements: "Enough germs are sent in each little package to inoculate seeds for from one to four acres. The package can be carried in your pocket, and yet does more work than several cartloads of fertilizer. It costs the government less than four cents a cake, or less than a cent an acre, and saves the farmer thirty or forty dollars, which he would have to spend for an equal amount of fertilizer." "If Malthus were living, he would have to revise his calculation of the time when the world will be so crammed with people that it cannot feed them." Mention is made of a Maryland farmer who inoculated an alfalfa field with marked benefit to the crop, — an experience in nowise unique at the present time; but note the comments: "This Maryland farmer had formerly been able to cultivate only one-third of his land; he had been obliged to abandon two-thirds because of the hopelessness of getting anything from it. Now, at no expense to himself and at trivial amount of labor, he had reclaimed the worthless two-thirds, and made it more productive than the other third. He has increased the yield of his farm, his income, fivefold; a generous living is now before him." "Nearly every State has its worn-out farming land, bringing despair to the economist who laments our careless handling of the fields, and who wonders how the country will support the hundreds of millions soon to be ours. The bacteria means intensive cultivation with a vengeance, and should give him hope."

Such generalizations as these may do for sensational magazine writing, in order to inflame the imagination of readers, but they do not fairly represent our present state of knowledge as to the practical value of soil inoculation with certain forms of bacteria. The fact probably is that many of the older cultivated lands of this country are thoroughly seeded with those bacteria which maintain a symbiotic relation to our more common legumes, such as the clovers, beans and peas. If red clover fails on a given piece of land, it is entirely possible, or even probable, that the soil environment is unfavorable to the clover plant, either as to food, root distribution or in some other particular. The improvement of the clover crop in such cases will not be brought about by adding more bacteria to those already present in the soil, but by improving the soil conditions through tillage, manuring, liming or in some other way. The suggestion that the distribution of certain forms of bacteria for application to the soil is going to cause the growth of wonderful crops, render fertilizers unnecessary, overcome the untoward soil conditions brought about by unwise methods, and thereby revolutionize farming, is arrant nonsense. Soil bacteria are not a cure-all for the ills of agriculture. Probably the introduction of certain new crops will be much aided by soil inoculation, as seems to be shown by our experiences with alfalfa and the soy bean. But in any case soil inoculation is a single factor in crop production, success resting largely, in the case of our long-cultivated legumes, upon soil management, and not upon a tube full of organisms. This is not said as an attempt to minimize in the least the importance of the investigations in question; they are of great value, and reflect much credit upon the scientists who have secured for us this marvellous insight into nature's methods.

In view of what I have said, you are doubtless wondering what conclusions I shall reach concerning certain speculations that have been recently placed before us by another great scientific bureau, — conclusions bearing directly upon your practical relations to the maintenance of farm fertility through the use of manures, either commercial or otherwise.

Doubtless enough has been said about Bulletin No. 22, issued by the United States Department of Agriculture. It is not strange that this publication should have attracted a great deal of attention, partly because of its source and partly because of the radical character of its statements. The uninformed were alarmed by its conclusions, and those well informed felt that in this publication the fundamentals of scientific demonstration had been ignored, and that doctrines had been promulgated which would be confusing rather than helpful to practical discussions, — even possibly antagonistic to the encouragement of sound practice. The general trend of this bulletin was to emphasize soil conditions, and minimize the importance of soil composition. It was an emphatic reaction against older views that were possibly as irrational and incomplete as many of us believe those of the bulletin in question to be. But we should endeavor to hold ourselves in an impartial attitude of mind, and not allow the real lessons of this discussion to be missed.

The public is certainly justified in gaining the impression from reading this bulletin that there are few soils which will not sustain satisfactory crop production indefinitely, provided proper physical conditions exist, and a sufficient water supply is available. In support of this statement, I quote from the bulletin in question: "Apparently, therefore, all these soils are amply supplied with the necessary mineral plant foods, and these plant foods are not in themselves a matter of such paramount importance to the agriculturist, for their supply as regards the plant is determined by the supply of soil moisture which the crop can obtain from the soil." "It appears, further, that practically all soils contain sufficient plant food for good crop yield, that this supply will be indefinitely maintained, and that the actual yield of plants adapted to the soil depends mainly, under favorable climatic conditions, upon the cultural methods and suitable crop rotation." It is natural that when the practitioner's attention has been called to these statements he should at once ask whether the teachers of agricultural science have been wrong in urging as conditions of first importance the careful preservation of farm manures and the judicious use of commercial fertilizers; whether, if the soil had been properly managed, its fertility would not have been maintained without any attempt to reinforce certain of its constituents.

It is important, therefore, for us to inquire, and I think we may do this without entering into unfair or unkind criticism, whether the status of scientific knowledge and the data which are presented in Bulletin No. 22 justify any important readjustment of existing thought touching the maintenance of soil fertility. The authors of the bulletin reach their conclusions partly through the consideration of pre-existing knowledge or theory, and partly from data which are the result of their own investigations. I have tried to give this bulletin careful and impartial study, and I am unable to see why the following is not a fair analysis of the reasoning which the authors adopt. If I may use the terms of formal logic, I would say that their syllogism is practically the following: —

1. Plants feed entirely upon the materials dissolved by soil water, and the plant roots do not function in making the solutions upon which the plant feeds.

2. The fertility of soils — that is, their crop-producing power — has "no apparent relation to the dissolved salts of the soils" (in water) as determined by methods devised by the authors.

3. Therefore, practically all soils will remain indefinitely fertile so long as right physical conditions and a sufficient supply of water are maintained. This is a remarkable syllogism, — remarkable in its premises as well as in its conclusion. The first weakness lies in the premises.

It yet remains to be proved that the present belief of plant physiologists in the power of plants to make their own solutions of plant food is erroneous. Certainly we have no demonstration that the soil water is the sole source of a plant's food, and there are many facts which inferentially, at least, indicate that our present views are correct. I have personally observed the fact that plants belonging to the Cruciferous family are able to secure their needed supply of phosphoric acid from the crudest and most insoluble materials, — a power which seems to be very largely wanting in Graminaceous plants. Observations of this kind have been repeatedly made in forcing-house experiments of the most exact character, and which are ratified by the experiences of field culture in the application of crude phosphates to turnips. How shall we explain these observations, unless we decide that one class of plants has a feeding power unlike that of another class? It is idle, with our present knowledge, to declare that the ability of one plant to secure its food where another one would starve is due wholly to a more sympathetic environment for the one plant than for the other; it is much more rational to conclude that one plant has a feeding power unlike the other. If, then, the plant itself is a factor, we step outside of the mere question of soil solutions.

In the second place, does the method of testing soils, adopted by the authors in Bulletin No. 22, viz., the treatment of a given weight of soil with a given volume of water for a brief period of time, actually test the capacity of the soil for sustaining plant growth, even if the soil solution is the sole source of the plant's sustenance? In answering this question I cannot do better than to quote from a recent editorial in the "Country Gentleman:" "It is confessed that the method 'does not tell us what concentration or exact composition of the soil solution in situ has,' and certainly the analytical procedure reveals nothing as to how rapidly or how continuously the soils in question will give up water-soluble material to meet the needs of a rapidly growing crop. While there may be justification for asserting that the weakest solutions obtained by the Bureau of Soils will support plant growth when constantly renewed, nothing whatever is shown as to possibility of such renewal in any given case, and no data are presented which show the effect of the composition of the soil on the rate, permanence and character of such renewal. The assumptions of the bulletin are to the effect that in any soil such a renewal will take place with sufficient rapidity to meet the needs of crops under all conditions of growth when the water supply is abundant. Is not this dangerous ground on which to advocate a reversal of our attitude toward the economics of plant nutrition? The premises involved in the above absurd syllogism are not supported, and, even if supported, are insufficient, and the reasoning is therefore not convincing."

The authors of Bulletin No. 22 seemed to be fully aware, as certainly they must be, of the marked results which for many years have followed the use of farm manures and commercial fertilizers; but they attempt to explain these results on other grounds than that manures and fertilizers add to the soil certain constituents which previously existed there in insufficient quantities. Their explanation seems to be that the fertilizers modify the physical characteristics of the soil or the chemical nature of the soil solutions, so that the water supply is improved, and the soil becomes a more sympathetic environment for the roots of the growing plant. To this point I shall refer later.

But, notwithstanding the fact that some of the teachings of this bulletin have been very generally rejected, many of the considerations urged in its pages are of first importance to the farmer. There is not the slightest doubt but that soil sterility is very often due, not to a lack of any of the constituents of the soil necessary to plant growth, but to unfavorable physical conditions or an insufficient water supply. Without question the farmers of this country have expended millions of dollars in attempting to do what might more cheaply and more efficiently have been accomplished by proper tillage and a rational system of rotation of crops, often by the introduction of organic matter into the soil. There is no excuse for us if we do not now give to the term fertility a more comprehensive meaning than has hitherto prevailed. It must be made to include water supply, soil color and temperature, as well as soil composition. The effects of poor soil management are not likely to be remedied with a bag of fertilizer, and there are hundreds of farmers who have conclusively shown that the bag of fertilizer has not been an essential factor in their success.

In view of the agencies which we now recognize as involved in soil fertility, is any less significance to be attached to the use of farm manures and purchased fertilizers? Shall we continue to urge the importance of animal husbandry and the careful saving of all kinds of home-produced manures, and shall we still encourage the judicious use of commercial manures? There certainly can be no question as to the profits which have resulted very generally from the use of fertilizers of all kinds; this is a fact not to be ignored, whatever we may regard as the explanation of the results of such practice. At the same time, if by any other means we are able to maintain soil fertility and produce satisfactory crops, there are certain expenses attached to the purchase of manurial substances which we might as well avoid.

Much depends upon what is the real explanation of the effect upon the soil of organic manures, as well as those which we ordinarily know as commercial. The soil physicist concedes the value of farm manures when applied to the soil, but he explains their influence by stating that they improve the physical condition of the soil. A strenuous advocate of the position taken in Bulletin No. 22 said to me that he would use all the farm manures possible on the soil of Long Island, which is notably light and over many areas is of a very low degree of fertility; but this advocate of the dominance of soil physics declared he would not use such manures because of the nitrogen, phosphoric acid and potash which they contain, but because they consist largely of organic matter. For myself, I am not prepared to abandon the old theories of feeding plants. Indeed, there is little reason for forsaking some of the fundamentals of plant nutrition as we now understand them. Who has not seen the roots of a plant centring around a bone which has been buried in the soil. Is this because of a better soil texture? What intensely luxuriant growth is induced where the carcass of an animal has been buried! Is this due to better water supply, finer texture of the soil, or any other condition excepting that of an over-abundant supply of plant food? What marked effects follow the application of nitrate of soda to a field of wheat, not only increasing very materially the growth of straw, but causing a much darker foliage! Have two or three hundred pounds of nitrate of soda so materially modified the water supply or the physical conditions of an acre of land as to cause this marked result? We have all of us noticed that where the old-fashioned and somewhat irrational method of dropping a handful of fertilizer in a hill of corn or potatoes has prevailed, spots of luxuriant growth have been seen in the grass field for several successive years. Are these merely spots of favorable soil texture and water supply? Is it fair to say that in the Lawes and Gilbert's notable experiments the decreasing yield of wheat on the unmanured plots and the persistent or increased production on those which have received commercial fertilizers are wholly due to a modification of physical conditions? Is the fertility of farms which have been well managed and well fertilized due wholly to a deference, conscious or unconscious, to the principles of soil physics, and is the sterility of the farm which we call exhausted wholly a matter of water supply and soil texture and temperature? To conclude that in all these instances which I have mentioned the supply of available plant food has had nothing to do with the prosperity of the farm crops, is to believe in an absurd proposition. The importance of water supply is conceded, the necessity for the proper tillage and rotation of crops is not disputed; but it is an almost universal experience that even when nature is kind with her downfall of rain, and when the farmer exercises the very best skill which is available in cultivating his land, there is still a large influence to be attributed to the supply of plant food which is introduced into the soil. When some scientist, by irrigation and by the introduction into the soil of organic matter containing no nitrogen, phosphoric acid or potash, and without the use of any purchased plant food whatever, accomplishes continuous successful crop production on some of the sandy plains of Massachusetts or New York, then, and then only, will we conclude that the fertilizer trade is a great mistake, and that farmers need only be solicitous about water and texture.

Please do not understand, however, that I come here to defend the use of commercial fertilizers as now practised by a large percentage of farmers. The way in which commercial manures have been used has to a large extent always been irrational, and, so far as I can see, is likely to be irrational in some measure for a long time to come. Permit me to illustrate what I mean by citing the conditions which exist in the State of New York. There have been registered for sale in that State for the year 1904 not far from 600 brands of fertilizers. These mixtures of compounds of nitrogen, phosphoric acid and potash, bearing all kinds of names, present a greatly varied composition, — indeed, they run the whole gamut of possibilities in their proportions of the three valuable ingredients; and I am unable to see, after giving the matter much consideration, how these mixtures, outside of a few cases of special fertilizers, are in any way intelligently correlated to the needs of various classes of farmers, or of any particular class.

Some years ago I had the honor to address this body on the subject of commercial plant food. At that time I very emphatically urged upon your attention what seemed to me to be an important fact, viz., that farmers were very generally failing to make an intelligent study of the needs of their particular farms, and were buying such fertilizers as the manufacturers happened to put in their hands, without any clear conception as to whether these mixtures were efficiently and economically strengthening the fertility of the soils under their control. Eight years have now passed, and I must confess that there has not been that improvement in the general practice pertaining to the use of fertilizers that I had hoped to see. The only general proposition which to my remembrance has ever been made concerning the feeding of plants, and which appeared to be based upon scientific facts, was made by the late Professor Stockbridge, who advocated the compounding of manures in accordance with the amounts of ingredients withdrawn from the soil by crops. On this basis mixtures known as the Stockbridge manures were placed upon the market. They were of high grade in texture and quality, and certainly were efficient, but of doubtful economy. Unless I mistake the tendencies of agricultural practice, the trend of opinion has been away from these mixtures during the past several years.

It is clear, I think, in view of our new factors of knowledge, previously referred to, that we should very largely abandon the mathematical basis of feeding plants. There is no force, certainly no business wisdom, in the proposition that we shall add potash to a soil rich in potash, for fear that it will some time become exhausted below the point of luxuriant crop production. When the soil needs potash, let us add it, but not until then. The rational thing for the farmer to do is to so maintain the land under his control that it is prepared for the production of the crop which he desires to grow. In other words, he is to make good the deficiencies of the soil when used for a particular purpose. The needs of the plants to be grown must be considered, of course, but our work is to prepare our fields to meet these needs.

But I am met with the old and somewhat stale objection that farmers do not know the needs of their land, and cannot learn them. What a low ideal this is to present to agricultural practice! The fact is, some of our more intelligent agriculturists, especially those producing fruit, are buying fertilizers with reference to what they have learned by experience to be their real needs; it may be potash in one case, phosphoric acid in another or nitrogenous compounds in another. These men have by observation discovered what are the applications which return profit, and at present they are not troubling themselves about complete manures or any other theoretical considerations. Those farmers who do not know the needs of their soil, and take no pains to learn them, — for they certainly may learn them in a very practical way, — are paying the penalty of ignorance.

I think that perhaps it is due to you, after this somewhat rambling address, that I shall lay before you what I regard as the best agricultural creed with reference to soil management that can be formulated in the light of existing knowledge: —

1. Thorough tillage, with efficient machinery, to be given if possible when the moisture conditions of the soil admit of satisfactory pulverization.

2. Frequent surface tillage at times of scanty rainfall, in order to conserve the supply of soil moisture.

3. A sufficiently rapid rotation of crops to insure good soil texture, to allow the necessary frequency of applying fertilizing material, and as a main result to secure a paying stand of crops.

4. The introduction into the soil at frequent intervals of an amount of organic matter necessary to proper soil texture and water-holding power, either by application of farm manures, by plowing under soiling crops or by the rotting of the turf.

5. The scrupulous saving of all the excrement of farm animals, both solid and liquid.

6. The purchase of plant food with due reference to the needs of the farm and to the system of farm management prevailing.

7. The maintenance in the soil of those conditions of drainage and aeration which promote the growth of desirable soil organisms, and the introduction into the soil, when necessary, of such organisms as are essential to the growth of particular plants.

The CHAIR. Discussion is now in order.

Mr. A. M. LYMAN (of Montague). Would the lecturer cultivate in rotation crops of tobacco and onions, for instance? In the Connecticut valley we have learned, after long years of experiment, that we get better crops of onions and tobacco when continued on the same fields. Also, isn't it a good idea for farmers to make their own soil tests, but on a smaller scale? Can we not easily find out what our soils need?

Dr. JORDAN. In regard to the question of tobacco and onions, I didn't mean by proper rotation of crops that you should always rotate; but in general farming, the general management of land for the dairy farm, there is no question but that there is such a thing as the "proper rotation of crops." But I must beg to be excused from going into the question of tobacco and onions, as I don't know very much about them.

In regard to soil tests, I get a great many requests for soil analysis, and they are mostly from city people. "I propose to grow onions; will you please tell me whether I can or not?" And they enclose a thimbleful of soil. I always write back and say, "This soil analysis is not at all competent to tell you whether you can grow a crop, or even tell you what you can put on the soil to make it more fertile." In general, soil analyses are to be advocated. I don't mean that from soil tests a man can learn everything, but I do mean to say that where he applies nitrogen alone, or potash alone, or phosphoric acid alone, he soon learns under his system of farming what things have a dominant influence to bring in the money.

Some will rise and say that the seasons differ. I grant it to some extent, but in a general way we now say at the experiment farm at Geneva that it is practically useless for us to buy potash. We do know that phosphoric acid and nitrogen are the two things that bring us profits; and we do know that when we are adding a rich cotton-seed manure a little phosphoric acid is about all we need on that land.

Mr. C. H. PARKER (of Holden). The lecturer has answered in part the question which I proposed to ask. He says he would know. I was going to ask him how he would know, but it seems it is by experiment. But the seasons differ, and the land differs in every field that I own, I think, and I don't know how I would know. We have experiment stations to test these things more carefully, and tell us what we don't know in reference to our land. I don't believe the farmers can find out. They are not careful enough to make these experiments so they would know anything about them from one year to another.

Dr. JORDAN. You have touched upon one of the difficult things, — that is, just how far an experiment station might serve you in determining or solving some of your business problems on your own farm. There is a certain limit beyond which we cannot go. I don't believe it is within the province of any experiment station to tell you whether you would better keep milch cows or raise pigs. I don't believe it is within the province of an experiment station to tell you how much you ought to feed your cows. It may give you certain general principles and certain fundamental facts; but, if I were getting 8 cents a quart for my milk, I would feed differently than if I were getting 90 cents a hundred pounds. I would feed them well at 8 cents a quart, and at 90 cents per hundred I would feed them as little as possible. I don't believe it is possible for an experiment station to experiment with fertilizers so generally that it would be able to tell so and so, after he has managed that farm for some time, just what he ought to use on it. It depends on his system in using the farm. I know that is a hard thing to say, and it is not very satisfying to say it, but it is the best I can do.

Mr. EDMUND HERSEY (of Hingham). I think there is no trouble in a farmer finding out what his land wants. He can test it himself a good deal better than can the experiment station a hundred miles off. I have tested my farm, and it has saved me a good many dollars. It is by trying different quantities of the three articles, one year after another, and then striking a balance. By keeping an exact account, you can tell what your ground will grow. I don't go to a man one hundred miles off, and ask him to mix my fertilizer; I don't believe he knows how.

Mr. Wm. H. Bowker (of Boston). I don't think I should have projected myself into this discussion if the manufacturers had not been pretty severely criticised by the lecturer, as you have all heard. Apparently we are in a tight place. We want to do what is right, and we ask the doctors to tell us what to do, and they don't dare to tell us. Even the good doctor here admits that he has not the courage to tell the farmers what to do, — that he is not the man to prescribe. Who, then, is?

There are great manufacturers of proprietary medicines, and the leading physicians of the country are prescribing these medicines. Why? Because they are put up in a large way on known definite formulas, which are printed on the packages, and are manufactured from drugs of known purity and strength; and the doctors believe it is safer to prescribe these things than to trust their prescriptions to the average druggist. We are in the position of the men who are manufacturing these proprietary medicines, where the formulas or analyses are known and printed on the package.

You come to us and ask us to give you something with which to grow a crop. We turn to the scientific man, — the doctor, — and ask him, and he has no answer. What do you think of the physician who tells you at your bedside that quinine and iron are good tonics, and then leaves you without giving you the form and the proportion? You wouldn't employ him longer, would you? You require that he shall prescribe for you a definite form and a definite quantity. Each of you has his own peculiar characteristics, but your physician prescribes, nevertheless, and his judgment is based upon his experience and the experience of others in his profession.

Professor Stockbridge, who died a few months ago, said that there were many things in the fertilizing of crops which we did not know about, but which he hoped time would solve. Nevertheless, he took the crop as his basis and said: "We will supply it as far as we know how with what it requires for an average crop under normal conditions in properly balanced manures." That was a good starting point. His crop formulas were modified by experiments, by the teachings of such men as Johnson, Sturtevant and

Atwater, and by the experience of practical farmers, — which, after all, is about the only safe guide.

You come to me to know what to use. Following the advice of the lecturer, I tell you to go back and find out what your soil contains or what it lacks, and then fertilize accordingly. You say: "I can't do that, — I haven't the time; I have got to apply something to-day." Then I say: "If you are going to raise corn, we have found that a very good mixture is 4 per cent ammonia, 10 per cent phosphoric acid and 7 per cent potash; for potatoes we have found that a mixture of 4, 7 and 7 will produce good results." Now, there is not a farmer here to-day but will use some kind of fertilizer next spring, and I put it to you now: if you are going to plant potatoes, what will you apply, and how much per acre? Answer me, now, that question.

Mr. PRATT. One ton to the acre.

Mr. BOWKER. Of what grade?

Mr. PRATT. The analysis you have just given.

Mr. BOWKER. Four, 7 and 7, — that is what you are going to apply?

Mr. PRATT. Yes, sir.

Mr. BOWKER. Now, whatever you use, whether you use one bag or one ton per acre, you have applied a definite quantity of ammonia, of potash and of phosphoric acid. That being the case, is it not right for us to say to you that to the best of our knowledge and belief you should use certain rational mixtures that are based partly upon the analysis of the crop and partly upon experience?

I don't believe altogether in the economic side of the question that we have had presented to us to-day; I don't believe in robbing the soil. I believe it is better to return, as far as we are able, what we take from the soil. What is the matter with our New England farms to-day? It is that your grandfather and my grandfather robbed the land, — robbed this generation, — which in my judgment they had no moral right to do. I feel that it is our duty as well as good practice to put back, as far as we are able to know, what we have taken out. Of course I would not carry it to the extent of returning all the nitrogen, because we know that there are certain classes of crops that assimilate from the great storehouse — the air — a certain portion of their nitrogen, so we can leave some part or all of it out. But when we come to the mineral ingredients, I believe we should return them. I believe we owe it not only to ourselves and to our children but to the State to preserve the fertility of our soils as far as it lies within our power to do so. That man is a good citizen who builds up his farm and preserves its fertility, not only for himself but for posterity; and any man who comes here and tells you that you can leave something out, particularly the potash, is advising you to follow a wrong principle, in my judgment. You can no doubt leave it out in many cases, but you are robbing the soil by just so much. In a word, you are taking the patrimony that belongs to your son, as well as reducing your own resources. We had a talk here yesterday about keeping our sons on the farm. I think a good many of them would have stayed on the farm if their fathers and grandfathers had not robbed it before they were born.

I am very glad that the doctor has spoken about the dignity of the business. I deplore misrepresentation on the part of any one. I am very happy to say that Massachusetts has done more to develop the fertilizer industry along right lines and to place it on a higher level than any State in the Union. Professor Stockbridge and President Clark went to our Legislature thirty years ago, and secured the passage of a law which in effect requires the manufacturer to "state what he sells, and sell what he states." That law was taken as the model for every fertilizer inspection law in the United States, and it raised not only the standard of the business, but of the men engaged in it. It was also Stockbridge, Clark and Goessmann and their friends who organized the experiment station at Amherst. It was started to solve just such problems as we have discussed here to-day. From the Amherst station and the New Haven station there have sprung forty-two experiment stations in this country; and out of these stations has grown the enlarged and improved Department of Agriculture at Washington, which is doing so much for the advancement of agriculture.

QUESTION. In this compound, of which 18 per cent is given, what is the other 82 per cent? Why not let us have 360 pounds, for instance, and not compel us to take 2,000?

Mr. BOWKER. I think the doctor here can explain that better than I can. I would attempt it, but he is here, and he will give you the chemistry of it.

Dr. JORDAN. It isn't the first time that the fertilizer manufacturer has appealed to the scientist to help him out of a hole. You needn't lay that up against the fertilizer manufacturer, though. There are some good things about him.

Why, my friend, this is the explanation. You see, he sells you nitrogen, but he has got to have that hitched to a lot of other stuff, in order to hold it. He sells you phosphoric acid and he sells you potash, but if he were to sell you actual phosphoric acid and actual potash, it would burn the skin all off your fingers, and would play all sorts of tricks on the crops; so he has to have them hitched to something that makes a pleasant compound to handle, and that the plants are willing to take. That is why you get the rest of it, with the exception — now I am going to answer that question just as I please — with the exception that when the manufacturers gather the sentiment of the farmers that buy a low-priced fertilizer, then they put in something. They do it because they believe it expedient in trade, because the farmer asks for it.

Mr. BOWKER. We sometimes make it from a low-grade material.

Dr. JORDAN. Yes, that is true.

Mr. E. A. WATERS (of Worcester). I want to ask one question, but before, I want to state a case about alfalfa. Some five years ago we cleaned up an old wood lot and cultivated it for two years, — I think it is three years since we seeded it. I don't know just the time of sowing that alfalfa, but some of it came up there and flourished, has done well. If we farmers here in New England would raise more alfalfa, soy beans, peas and oats for our stock, we wouldn't have to discuss this fertilizing question so much; we would be putting back into the land what our fathers took from it years ago.

Now, I want to ask the doctor if he thinks it possible to raise alfalfa on virgin soil without using bacteria; and I also want to ask him if he thinks it is possible to raise soy beans here in New England, in this climate, and have them come to maturity, — to raise beans that will grow in their season without using bacteria?

Dr. JORDAN. It is claimed in the State of New York — and I tell you we are in the range of somewhat uncertain knowledge — that wherever sweet clover is abundant alfalfa will do well without any inoculation. Certain it is that in many places in New York where it was never grown before it grows all right from the start, without any soil inoculation, and in certain other places it does not. I expect it is an experimental question in the particular region where it is to be grown.

I wish that the alfalfa plant might become generally distributed through certain sections of Massachusetts. I don't know whether it can or not. We have had it twenty years on our experiment farm. The only thing we find it necessary to do to keep an alfalfa farm going is to charge it with a certain amount of acid phosphate or some other lime.

Mr. WATERS. What do you mean by sweet clover?

Dr. JORDAN. It is a legume that grows tall, with a very small white blossom, and has to me a sickening sweetish odor, unpleasant.

Prof. WM. P. BROOKS. We grow it at Amherst, but it generally disappears after sowing. There may be locations which I have never visited where it is found, but in going about the State as I have, I have never seen sweet clover growing wild.

Dr. JORDAN. It is distributed all through the State of New York, and it is claimed there that where that is abundant the alfalfa will do well. On the experiment farm we arrange it in this way: we sow it the first time on land that has been cultivated the previous year, so as to have no weeds; then we sow it as early as we can. We put on a lot of seed, 30 pounds to an acre, so as to have the stems thick and fine. After it gets to a certain height the weeds will be higher, and we cut the weeds down. In a season with plenty of moisture we are sometimes able to get two good crops of alfalfa the first season. Last year our old alfalfa fields were absolutely killed out, — our first experience in twenty years. We cut of green alfalfa from 20 to 30 tons. It is equal in an average year to about 5 tons of hay. We use it largely for summer feed for our dairy cows. It is surprising how small a piece of good alfalfa it takes to keep ten cows. We cut it in long strips, and begin at one end, and by the time we reach the other end we can begin back on this end. I remember one year when we cut five good crops, although four is more nearly what we generally do.

QUESTION. What seemed to be the trouble last year?

Dr. JORDAN. We had an unusually severe winter, and we found the roots sticking out of the ground. I don't know how the frost ever lifted an alfalfa root, but it did; it was a strong frost. When we put on a couple of horses, the roots were pulled out, and as they turned it over, it looked like a field of little sticks.

Mr. WATERS. The second question was, if it was possible to raise soy beans and have them come to maturity without this bacteria.

Dr. JORDAN. I know this, that in the State of New York and other places the soy bean has responded very uniformly, and the chances are you will get benefit from inoculation in growing soy beans in the State of Massachusetts. I should think you would get it with sufficient maturity to use as corn and ensilage. I think it would be well for you to try cow beans on your land. We get a better growth of cow beans at Geneva, and we grow it without any inoculation.

Professor BROOKS. I will answer in a very small way. A year ago I sowed one or two rows of soy beans, and they stayed out all winter; they came up and sprouted this last spring.

Mr. WATERS. I would say that we raised between five and six acres of soy beans this past season, and inoculated the seed. They came to maturity, and we got a good growth.

I am sorry to say that I cannot tell very well what the results would have been from that venture, for the reason that the most of our stock was sold the 1st of November. We reduced the grain ration one-half, and they seem to be doing just as well. You must feed cows something that has protein in it, and if you cannot buy it, you will have to go to work and raise it on your own farm.

The CHAIR. May we hear from Dr. Wiley this afternoon?

Dr. H. W. WILEY (of Washington, D. C.). I simply want to say, in regard to the theme of the afternoon, that I think it is the fundamental theme of agriculture, — the fertility of the soil. And I must say, upon the whole, that I pretty generally agree with all the lecturer has said. Of course the fertility of the soil is to be regarded in two lights: the potential fertility, that is, how much matter has the soil in it which is available for plant growth; and the second, kinetic, or how much matter has the soil available for the use of the plant. It is hardly necessary to discuss the question of environment, because a crop is more climatic than is soil. You must remember that no amount of climate can make a crop where there is no plant food, and no amount of plant food can make a crop where there is no climate. You may take the fertile soils of the south and transfer them to the north, but no amount of labor will enable you to grow bananas, pineapples and oranges. All these things must be considered in discussing the matter.

Now, to put aside all environment except the soil itself, for that is the only way we can get at this question, — that is, assuming the environment is favorable, because to a certain extent man can control not only the soil but also the environment. You can put up a greenhouse here and grow tropical fruits in South Framingham; and you can take the poorest soil in Massachusetts and grow any crop you want to, by fertilizing it, in the same way. So in that respect man controls both environment and the soil. If he takes from arid regions soils that would grow nothing in their natural environment, he can convert them to the most fertile soils in the world. I will say that man's influence over the soils is far more easily exercised than it is over the climate.

While we may make the climate in a small way, we may take the soil in the state in which we find it, and change it, and there man's influence is most pronounced. Any soil that contains less of any plant food than is needed is absolutely sterile, no matter how rich it may be in the other ingredients; that is, if it has 12 per cent available potash and 12 per cent phosphoric acid, and has no nitrogen, you cannot grow any crop. The plant eats the soil, practically, in which it is placed, and the steer does not; and that is where the difficulty of the problem comes in. If you could put a steer in a stall and feed it partly on the stall and partly on the crib, the problem of feeding it would be very complicated. You would have to know how much nourishment it was getting out of the crib and how much out of the stall. And you might have a field with 100 tons of plant food in it, but if the plant cannot get at it, it will starve. These are the fundamental principles of feeding plants a balanced ration, just as you would feed a steer.

We have shown in our experiments that a plant feeds, as a plant, according to the amount of the loose, available, essential plant food which it can get, — that is a fundamental proposition; but if a plant can get but a little bit of an essential plant food, not enough to make a crop, it may feed on the other food to a certain extent. If the nitrogen is deficient, we find exactly what Dr. Jordan has said. When you find this, you must balance your ration in such a way that the least abundant plant food in the soil will be increased to a sufficient quantity to make a normal crop. That is what the farmer wants to do. He doesn't want to rob his son or his grandson, but he wants to feed his crop in a way to be most economically produced. And he ought to know something about the relative abundance of the materials in his soil. I won't go into the subject as to how that is to be found out. I know the experiment station cannot analyze the soil of every farm in the State. The farmer must take part in the work, as has been suggested.

I will tell you what we have done in the south. There the problem is quite simple, because the soil in the south is almost pure sand, — contains scarcely any plant food at all. Yet it does contain a little plant food. There we find, by adding just a little potash to one strip, and phosphoric acid to another strip, and nitrogen to another, and defining them 1, 2 and 3, that we can determine which combination will produce the largest return. In a soil like that, that is the combination you want to add. In a soil like this, which has an abundance of plant food in it, you want to add to the least abundant. Nitrogen and phosphoric acid, perhaps, are deficient, but this can be easily determined.

You have got to feed your soils, as Mr. Bowker said. Years ago I proclaimed that the ordinary system of agriculture which was in existence in the west, where I was brought up, was nothing short of highway robbery. I have seen it with my own eyes, on the frontier, on those rich soils where they would move their stables to avoid taking out their manure, — it was cheaper. When the manure got so high that the stock could not enter, they would move their stables. They removed every particle of the corn stalks and straw which they produced, changed crops year after year, until that wonderful fertility of the virgin soil is reduced to almost the minimum of the soils of the east. That is what I call highway robbery, — absolutely taking from the soil all the time, and not giving it back. A farmer is a moral farmer when he leaves the land in a better condition than he found it, so, when his son comes to take his place, his lands are in a better condition. And it is the duty of every farmer, to the State and to himself, to leave his fields more fertile than he finds them.

Next, our agricultural exhibits are too small. Of course, there are certain limits which nature will not allow you to go beyond, but you can approximate them, little by little; and that is the duty of a farmer, — to approximate the maximum limit which nature permits. And when he does that, he can grow three times as much. The sugar beet will illustrate that better than any other. It is impossible to grow it without scientific agriculture. Why is there not more of it? Because the agricultural department is not up to the standard. The manufacture is all right, and the price of sugar is all right; but the farmers don't grow the beets, and therefore the sugar cannot be made. The land is not tilled as it should be, and the crops are not properly rotated in order to produce the best results. And we never will succeed in this undertaking until the agricultural department is improved. Last week I saw a magnificent sugar factory, preparing sugar for the table. They were turning out thousands of tons of beet sugar. "How long have you been running?" I asked. "Three weeks," was the reply. "How long will you run?" "Another week." Four weeks, — with that magnificent factory, with that magnificent result! To be stopped in the midst of its work, simply because it had no beets to work with! And with that splendid soil, and the climate, — which is the most important thing in growing beets, — and the beets pulverizing 14 and 15 per cent; and the factory not getting enough to work with, simply because the farmers don't understand the scientific principles of growing beets, and don't want to learn. But I am glad to say they are very rapidly improving in this respect. Five or six years from now that factory will be running three or four months a year.

I believe that the great work of the agricultural experiment station and of the agricultural college is the great work of agriculture in this country, because it teaches the farmer directly how to increase his yield of profits by a systematic and scientific manner of feeding his plants; and how the food has got to come from all over the world, from where it can be had; from the atmosphere, a lot of it; from the soil, a part of it; from distant countries, a part of it, when those stores which nature has been laying by in the past are made available. There is enough phosphoric acid in the State of Tennessee to supply the whole demand of the United States for five hundred years. It is to be taken out and brought where it is needed. In South America nitrogen is plentiful, and will be made available. In Germany there has been discovered potash, and the throwing down of potash is not confined to Germany alone. These have got to be gathered and brought here to be used.

But even then economy in the use of the fertilizer and in saving the farm manure must be increased, so nothing will be wasted; and we must sell those things which take the least from the farm, — our butter and milk and sugar, — and feed on the farm those things that will bring back to it what has been taken out. The American farmer will go forward in the improvement of his farm, in the increasing of his profits, and in that moral agriculture of which I have spoken, which will leave his fields in a better condition than he found them.

Dr. Jordan. I will not weary you one moment, but I don't want to be considered unpatriotic, or as traitorous to the best interests of my country. Mr. Bowker made an appeal to your patriotism, in which sentiment I most heartily join; but there is a practical side to patriotism. We have at Geneva an Onondaga clay which we find contains 100,000 tons of potash per acre, to the depth of 1 foot. Now, supposing I adopt the patriotic point of view in feeding the plant, and add every year to that 100,000 tons as much as the crops take out, I shall have made amends to the amount of 100,000 tons; but if I do not replace what the crops take out, and in the course of a century I have reduced that potash to nothing, I wouldn't have to do any more than I did in the beginning, and that is, add what I took out. So I don't really see how my grandson, if I had one, would have to do any more than to add what the crops had taken out, even if I took half of it out. Perhaps my logic is bad, but really my patriotism is all right, and I think my logic is as good as my patriotism.

Mr. Bowker. Is that potash all available?

Dr. Jordan. Oh, no; but we find at present it is available to the extent of good crops; and when the time comes that it isn't, if I add all the crops have taken out, I think I will have added enough, and I don't expect I will have to do it for fifty years.

Adjourned.

Evening Session.

The evening session was held at 8.15 o'clock, First Vice-President Sessions in the chair. The gathering was in the nature of a reception to the Board of Agriculture and others attending the meeting. His Excellency John L. Bates, Governor, ex officio president of the Board, was present. Miss Edna Dean Proctor was present by request, and recited an original poem, entitled "Columbia's Emblem," the golden corn.

The Chair invited Dr. L. M. Palmer of South Framingham, the representative of the Board of Trade and the citizens of the town, to extend greeting.

ADDRESS BY DR. L. M. PALMER.

Mr. Chairman, His Excellency the Governor, ladies and gentlemen, it is my very pleasing duty and privilege and honor to extend to you the greeting of the Framingham Board of Trade, and to bring to you the heartiest good will and wishes of the good town of Framingham. I think it is perfectly justifiable in me to-night if I assume a little spirit of boasting, and say that I am proud to speak for the good old town of Framingham. We are proud of the fact that that prince of men, Oliver Wendell Holmes, once said that his ideal of life was to have a home in the city of Boston and a country home in a beautiful town like Framingham. We are proud, sir, of our public school system. We are proud of our State normal school,—the oldest normal school in the State. We are proud, sir, of our churches, and the good moral tone in our town. We are proud, sir, of our State muster field, where we have received for many years the army of the State, of which you have the honor to be the Commander-in-Chief. It is generally acknowledged that you look well upon horseback; we are glad to meet you upon a peace footing. I regret very much that it is not within my power to speak as a farmer. I was a farmer once, and, if I had been consulted upon the matter, no higher honor could have been conferred upon me than to have been a farmer's son. My friends are disposed to poke fun at me when I say my highest ambition in life at the present time is to be able to say that I am a farmer, and a member of the Middlesex South Agricultural Society. But for the past twenty-five years my farming has been only public farming. I greet you, sir, in the name of the Framingham Board of Trade and of its citizens. You have visited us many times as a militiaman and as Commander-in-Chief; we greet you to-day as a peace man. There are others who will also greet you, and I will not take further time; only this please allow me to say: the veriest school boy and school girl remembers those classic words of Henry Clay, "I had rather be right than President." We greet you, Your Excellency, as a man who dared and preferred to do what you thought was right, rather than be Governor of the Commonwealth of Massachusetts.

The CHAIR. Ladies and gentlemen, allow me the honor of introducing to you the Governor of the Commonwealth of Massachusetts, Hon. John L. Bates.

ADDRESS BY HIS EXCELLENCY GOVERNOR BATES.

I was just going to call the Chair "Mr. President," but I am reminded that I am the president of the Massachusetts State Board of Agriculture, and I feel just a little as though, in being called upon, some one was usurping my rights, and that I should be calling on some one else to speak; and that, if any one was going to do the dictating on this occasion, I should be the one, for since the Board of Agriculture was first organized the Governor of the Commonwealth has been ex officio president of it, and is still president of it. But there have been so many years since he has been the active president, that I am not surprised that the vice-president this evening takes the chair and issues his orders to the president.

I very much appreciate the words of Dr. Palmer. I feel as though I was not entitled to all that he says, and at the same time I find much cause for gratification in his generous sentiments.

The pride of the town is well founded, and no one could listen to his remarks without recognizing that fact. As he spoke of what there is here, I could but think that here we see the Commonwealth in miniature.

He spoke of the public school system, which began away back in the wilderness, and has always been identified with the Commonwealth of Massachusetts. We gave to the world the first free public school supported by taxation; and I am not surprised that a town in this State should mention the public school as the first thing in which it finds occasion to rejoice.

Then he mentioned the churches. Well we know that the spire of the church arose by the side of the schoolhouse when the settlers first came and made their landing on our shores; and in that, too, the town is typical of Massachusetts, from the very beginning.

Then he mentioned the normal school, — not exactly a crowning glory, but something that binds the public school system together, that makes it effective, that insures that all the schools throughout the State shall have trained teachers to do that work which is the most valuable work, — to train the young thought of the Commonwealth.

Then he mentions the camping ground, the place where our militia gather from season to season. It is indicative of the strong arm of the Commonwealth; indicative of the courage and the determination of the men who settled in the wilderness, and who had to fight for their foothold on the continent against the wild child of the forest; and whose descendants inherited that passion for freedom and breathed the air of liberty so long that they could not be curbed, and went out to stir the fires of revolution, and were willing to meet the consequences with guns upon their shoulders; the men who, through our whole history, have been the ones that have preserved our rights and liberties.

It is the State Board of Agriculture that is being greeted to-night, reminding us not merely that peoples are dependent on the tilling of the soil, but also of the fact that those who early came to this Commonwealth were men who had the enterprise and the perseverance to obtain crops where ordinarily it would have been considered almost impossible. They so developed this land that we have acres that are able to produce as high a percentage in values as any acres in the world. I do not know how there could be a greater combination of the things that have made Massachusetts great than those that are suggested by this occasion, and by the words of the one who so kindly extended the greeting to us this evening.

I have had my way with the Board of Agriculture but once this year, and that was when Mr. Ellsworth came to my office some two or three months ago, and wanted to know if I would attend this winter meeting. I told him it would give me great pleasure to attend, provided the exercises were such as not to require preparation. "Well," he said, "we propose to have a banquet, and propose to have you say a few words." I said, "That will be very easy; if you had invited me to give an address, that would have been impossible, for I am too busy to find any time to prepare addresses; and it wouldn't be right to have the people come together expecting an address, and find that the Governor had come only for the purpose of extending a few words of greeting." "Well," he said, "we will arrange that." He came back again ten days later, and showed me the circular in which he had me down for an address, and that was the only thing on the programme. I asked, "How does this happen, Mr. Secretary?" "Well," he replied, "you know we have a way of running things about as we want to, and we have changed our programme; that is all." "Well," I said, "I see you have, but you have me in trouble now, and you will have to change your programme again." And, for a wonder, I found he was quite tractable. He changed the programme, and said, "If you will come, we will have a reception to the State Board of Agriculture, and we will only expect you to say a few words of greeting." I mention this because it is the first time I have had my way with this Board of Agriculture, and I wanted you to know that I had had my way once.

There were various reasons why I didn't propose to come out here and deliver an address. In the first place, I thought the only proper kind of an address would be an address on agriculture; and I suggested to him that I had made one attempt at that before the Legislature, and that my views hadn't seemed to meet with his approval or with that of the Board, and I didn't propose to get into any more trouble on that line. At any rate, my excuses seemed to be sufficient, and so I am here this evening merely to express the greeting of the Commonwealth of Massachusetts, particularly to the members of the Board of Agriculture; but I feel as though I could not proceed to do that without saying one word more in regard to the town that has given us so pleasant a reception.

I have spoken of these foundation stones in which it takes its pride. There is something more. The one who presented the greeting represented the Board of Trade here, — the Board of Trade, — an important institution in any community; an institution that may make much for the prosperity of a people. I was pleased on the train to-night to learn of the enterprise of your citizens, who are not satisfied with their beautiful homes, and their schools, and their choice farms, and their industries already established, but are reaching out to gather in more; and I was pleased to know that your efforts are likely to be successful, and that you are soon to locate another industry here. I want to congratulate the town on the reputation that it has for enterprise, and as a clean, wholesome place of residence, that makes it a place that people like to live in and to establish industries in.

The State Board of Agriculture is but one indication of what Massachusetts is doing in the interest of the farm. We produce each year about $1,200,000,000 worth of manufactures. I think the value of the farm products of Massachusetts is about $42,000,000. The manufactures are about thirty times as valuable, and yet we have no Board of Manufactures, we have no Board of Commerce, we have no Board of Trade under the authority of the State and supported by the State. The only industries which have official recognition in that way are the fish industry, which is partially recognized in the Fish and Game Commission, and the agricultural industry, which is recognized in the Board of Agriculture. I presume one reason for this is the recognized fact that all industries are in a way dependent upon the agricultural industry. We speak of our cotton mills, and we have at once to recognize that they are dependent upon agriculture for the raw material. We speak of our woolen mills, and we recognize that they are also dependent upon the farmers for the raw material. So it is also with the boot and shoe industry. And so the industry which we call agricultural supplies the material at the foundation of many industries, and also the necessities of life for those engaged in them. It was in recognition of these facts that, in the time of the Persians, the monarch would leave his throne once a year and go down and eat with the husbandmen. The ancient kings of India used to have a formal ceremony once each year, in the spring time, when they would go out and open the ground. And the emperor of China, down to the present day, orders the husbandman who has had the greatest success during the year to be brought before him, in order that he may be created a noble of high rank. When men have dreamed of a better civilization, and have tried to describe the ideal conditions of life, they have had something of the same fascination leading them on as seems to have taken possession of Dr. Palmer. He, not having been born a son of a farmer, hopes he may die a farmer; and I suppose every business man who is enclosed between the walls of the great cities is looking forward to a time when he shall have accumulated enough so he can go out on a farm and enjoy some of its pleasures. Moore, when he wrote about Utopia, described the people of Utopia as a people all of whom understood the art of farming, and knew how to raise products. The art was taught in the schools in the land he described, — a land where everybody was happy, and all the best conditions prevailed.

And there was another who wrote about a city of the gods, the City of the Sun. He described the condition of a people given to agriculture, and all instructed in the science of it. Then he told how they would go out in processions, with flags and with banners, and with trumpets sounding, in order that they might plow the ground, indicating the dependence of humanity on the coming of the crops, and also the faith of humanity that the crops were sure to come, if man did but do his part.

Massachusetts has recognized the importance of this industry in many ways. We have made some progress during the last two years. During the last year we have established a State forestry department and appointed a State Forester. For many years it has been recognized that something could be done on this line to benefit the farm and the State. It was thought, if there were an expert who was skilled in such matters, that he could be of assistance to the farmer by showing how lands could be improved that now are idle. It was recognized that the time was coming when the State must restore some of its forests, if it would preserve its water supply, either for power in its mills or for the needs of the great cities. It was recognized, furthermore, that these forests would, in the course of time, as they have in other lands, become a source of income. There has been a desire for a long time that something be done. Something has been done, and we are looking forward confidently to a growth of forests in this Commonwealth that will add to the beauty of the State; that will be of great service in its protection of the supply of water; in its protection, incidentally, if you please, of the wild game of the wood; and of value in making waste lands sources of revenue, because of the timber that may be produced from them.

There has also been an advance made within recent months in connection with the highways. We were pursuing a policy of building State highways in this State by means of an appropriation that was made from year to year; and the State Highway Commissioners never knew when some economical government might come in and say, "We will stop that appropriation; we will cut it off." They never could plan ahead, because they could only plan to spend the money already appropriated; and the result was that the work was carried on more expensively than it would have been otherwise. Now that is changed. The work has been established on a five-year basis, so the commissioners can plan five years ahead, knowing their appropriation is certain. A more harmonious and comprehensive system of roads and greater economy in their construction will be the result of this new policy.

And there has been another advance. We have set out 4,000 trees. It is the first time the State has set out trees along the lines of the State highways. These are to be followed by more; and it is believed in the course of time that the growth of these trees will add very much to the picturesque character of the highways of this Commonwealth. Some of our roads are already famous because of their beauty, due to the wide-spreading elms that were planted a hundred years ago, and the shade of which we enjoy to-day.

There has been an advance in some other directions, in which the farmer is particularly interested. We are reclaiming a thousand acres of land at Rutland by the labor of prisoners. It is more or less an experiment. It has been possible under the statute for years to make the attempt, but no attempt has been made until the past year. A thousand acres have been taken, and prisoners put to work. The land, practically valueless when taken, is to be developed so as to become valuable farm property, thereby not only adding taxable value to the Commonwealth, but, as an example, showing the way in which other lands may be similarly improved.

I was greatly interested yesterday to read that portion of the President's address to Congress in which he deals with agriculture. Over a column of the morning newspaper, I found, was devoted to that one subject. President Roosevelt describes the "department of agriculture" as a great educational institution, having over two thousand specialists, who are making researches in every known field of agricultural interests. They are examining the soil in the various parts of the country. They are collecting grains and fruits from all over the world, and making experiments for their cultivation here. They are also endeavoring to fight the enemies of the farm. They are meeting the destructive insect with the destructive insect.

Six millions a year is expended by that department, and over $10,000,000 a year for the agricultural colleges and the various experiment stations, and the researches that are being carried on by specialists. And all this is done because our people recognize the importance of the industry which to-day engages one-half of the people of the American nation.

I heard Booker Washington say last Sunday that at Tuskegee they have many acres of land connected with the institution, which, when bought a few years ago, was not considered worth anything for tillage purposes. They bought it for $2 an acre, and the people were very glad to get rid of it. But he said no land in that vicinity could now be bought for $100 an acre, because it had been learned that peaches would grow on that land better than on any other land in the country. It was a discovery of great value to that section. It is experiments which are leading to such discoveries as these that the national government is making.

I remember that when south recently I found the cotton growers particularly pleased because the national government had found an ant that would prey upon and destroy the insect that was destroying the cotton crop.

We have a problem in this State, and I am glad to see that one of our Congressmen has introduced a bill in the national Legislature providing for national help in fighting the gypsy moth. It is just as important for the national government to be interested in this as in the insect that was destroying the cotton crop in the south; just as important as it was to be interested in the disease that was killing the cattle in this Commonwealth about two years ago, and which threatened so much destruction. It is in the interest of the nation, but the Commonwealth, the locality and the individual cannot neglect their duty in this matter.

In other ways the national government is giving aid. It tells the farmer of the coming of the storm and of the changes in temperature. Our own agricultural department is doing for the State what is being done by the nation for the entire country. It is working along similar lines, and the more successful it is, the greater will become the agricultural interests of this Commonwealth.

I did not intend to talk to you so long, but there is one who, I understand, is to favor us with a poem, and she was kind enough to tell me the subject of it. It reminded me of the words of Edward Everett, when he delivered his famous address on vegetable and mineral gold, where he compared the vegetable gold to the mineral gold. He called attention to the fact that the gold that came from California was lifeless; that it was of no value, except as it was exchanged for something else; that you could not build a house with it, you could not warm yourself with it, you could not clothe yourself with it, you could not eat it. After you had once taken the crop from the ground, you could not get another crop from it; the ground was left barren, stony and valueless. And then he went on to speak of the other gold, the vegetable gold. He told how, if you drop it in the earth, it swells, expands, and gradually sends up a little shoot that pushes its way above the soil. The grain, he says, is golden; it is buried, and sends up a little shoot of emerald green. It flourishes, it laughs and revels in the sunshine and the air, and puts forth its leaves. It becomes a great stalk, and towers aloft with fluttering tassel, and brings forth of new golden grain a hundredfold, that will become flesh and bone and muscle, — artery and vein and throbbing pulse. It will become, indeed, the staff of life, — the staff upon which man has been leaning throughout all the ages. Such are the pictures that the husbandman has before him constantly. They reveal something of the charm to the man of the city of the life on the farm. I congratulate those who have the opportunity to be engaged in such a delightful and important work.

Brief addresses were also made by Dr. H. W. Wiley, chemist of the United States Department of Agriculture, and by Dr. W. H. Jordan, director of the New York Agricultural Experiment Station. Pleasing vocal selections were rendered by Miss Carol Livers of Boston, accompanied by Miss Sarah M. Damon of Wayland.

THIRD DAY.

The meeting was called to order at 10 A.M. by Secretary Ellsworth, who introduced Mr. Arthur A. Smith of Colrain as the presiding officer.

The CHAIR. It is my privilege to preside at this closing session of this winter meeting of the State Board of Agriculture. For many years I have been a member of this Board, and this, I am free to say, has been one of the — yes, perhaps the most successful meeting that I have ever attended. I predict for the town of Framingham a continuous prosperity, not only in the great industry of agriculture, but in the other industries of the town also. I take great pleasure in introducing to you a man whom you have all grown to love during this meeting of the Board of Agriculture, Dr. H. W. Wiley, chief of the Bureau of Chemistry of the United States Department of Agriculture.

FOOD ADULTERATION AND THE FARMER.

BY DR. H. W. WILEY, WASHINGTON, D. C.

The subject of food is one that interests us all, — at least about three times a day; between meals we may consider other subjects of public importance. It seems, however, only fitting that in an agricultural meeting a place should be given now and then to the discussion of the products of the farm as they reach the consumer. In other words, the farmer has a direct interest, not only in the production of the foods which feed the world, but also in their subsequent treatment, just as we would follow any other product with interest up to the time of its final use. Usually the subject of adulteration of food is considered only from the manufacturer's or from the consumer's point of view; it is rare that it is treated from the farmer's point of view. It is particularly to this last phase of the subject that I will call your attention this morning.

The products of the farm are used for the food and clothing of humanity; therefore agriculture lies at the very base of human life. As agriculture prospers, all other industries prosper; when agriculture fails, all other industries fail. You cannot have a man work unless he is fed, whether that work be of a physical character or mental character. Every employee in every factory has his work measured largely by his nourishment, just as a farmer cannot take an ill-nourished steer or horse into the field and get good work out of him; he must feed him well, if he wants the maximum result. So the laborer must be well fed, if you wish to get the maximum result of his work, and he must be well clothed. And these, food and clothing, are the great products of the farm.

We might get along for the time being without almost any other industry. For instance, we did get along last year — with some difficulty, to be sure — with a very limited supply of coal. There are other ways in which we can get warm, without depending altogether upon coal, because it is perfectly certain that the time will come — I don't know when that will be — when there will be no more coal. By that time, human ingenuity must devise some other human effort in keeping warm, — and we came near doing that last winter. We can get along without a great many manufactured products, to be sure with inconvenience; but the very moment you strike down the products of the farm, you put man in a position where he cannot exist at all, — he must have food; he must have food, and his food, to be efficient, must be wholesome. It must be what it pretends to be, or else the farmer's labors are in vain.

If the farmer prepares food to be offered in a state fit for consumption, as some of it is at the time it leaves the farm, or in the raw material, as it is in most cases, and then after it leaves his hands it is subjected to a process of adulteration, the change has altered its value to a certain extent. Agricultural industries are injured to that extent, so that the farmer, I say, holds not only the general interest as the consumer in the subject of food adulteration, but a still further interest as a producer both of the material itself as food and the raw materials from which foods are manufactured.

Now, right at the beginning let us understand what food adulteration is, because here is a point where there is a great difference of opinion. A great many people think that food adulteration consists simply in adding to foods things which are injurious to health; that is a very common view. Any other change that foods may undergo, to the disadvantage of the farmer or of the consumer, is not considered an adulteration. That I consider to be a very narrow view; as far as food adulteration goes, it covers only a very narrow portion of the field.

Then, again, there is another view, which regards as food adulteration any change at all which may take place in the character of the food to its detriment, and especially any change which deceives the consumer. Now, that I consider to be the dominant feature in food adulteration, — changes in food products which deceive the consumer. There are hundreds of those which are detrimental to the agricultural interests, and many are detrimental to the consumer in other respects, especially in depriving him of his money; so that food adulteration must be looked at in both of these aspects, as a process which may be injurious to health and as a process which may be fraudulent in its nature, and just as much to be reprimanded as any process that would deprive you, through fraudulent pretence, of your money.

I want to illustrate, before applying these principles to agriculture, some of these phases of adulteration to which I have alluded, viz.: first, those things which are positively injurious to health; and, second, those things which are fraudulent in their nature.

Now, take any product, — any one that you might happen to mention, — I will use one which is a very common product, *i.e.*, milk. Milk which is unadulterated is the milk, the whole milk, of the cow or of the herd, — absolutely all of it; that is milk. Now, sometimes the farmer himself becomes, I am sorry to say I have been told, an adulterator of food. For instance, suppose the farmer or dairyman in milking his cows does this: he milks a part of it, which is less rich in fat than the whole, and sends that to market as milk; and then milks the rest and sends it to market as cream. That is adulteration, because it is neither milk nor cream that is sold. Milk is the whole contents of the udder of the individual cow, or of all the cows in the herd when mixed together, and cream is what rises to the surface or is separated by mechanical means from whole milk after milking; therefore, the sale of part of the milk as milk, and the rest of it as cream, is adulteration. There, perhaps, is no injury to health in this, except where milk, which is an almost perfect food, is prescribed as a food, for instance, to an invalid, on the supposition that it is the whole milk; if a portion of it be extracted, so that the balance of the ration is changed, that milk may be injurious to health. Whole milk is, I say, an almost perfectly balanced ration, especially for invalids and infants; and therefore, if administered to an invalid or infant, it should be exactly what it pretends to be. The physician may write a formula for a modification of milk, and then it is always proper to have the milk conform to that modified formula, because it may be necessary in certain conditions of diseases or invalidism; but in no other case is it proper to change the constitution of milk and sell it as milk.

There is a very common adulteration, as you know, which, unfortunately, is accomplished in this way. Almost every city and State has fixed a standard for milk; and now under an act of Congress the United States has fixed a standard for milk, — these standards prescribe that milk shall not contain less than a certain proportion of fat. Now, advantage is taken of that by some dealers, who take a richer milk and reduce it to the standard; and that is just as much an adulteration as if no standard existed. When you fix a standard for milk, it means that whole milk must at least come up to this standard, — it does not mean that whole milk shall be reduced to this standard, at all; and therefore any one who takes the whole milk which is above standard and so manipulates it, either by extracting the fat or by adding water to the milk, so as to reduce it to a legal standard, is just as guilty of adulteration as if no standard existed. The object of a standard is not to legalize adulteration, but to fix a limit beyond which whole milk shall not go.

You heard what was said yesterday about the Holstein cow in the dairy. The Holstein cow gives, as you know, a milk which is phenomenally low in fat, and therefore it is not a suitable animal to make a whole dairy herd of; and a standard prescribing a certain amount of fat would exclude from standard milk a whole milk — absolutely whole — if it was given by a cow which did not give that standard of milk, although the milk would not be an artificial article.

This illustrates how a food product may be manipulated upon a farm, or after it leaves the farmer's hands, in order to get greater gain. Remember, that is the object of this manipulation, — it is not to injure your health, but to get more for the product than otherwise could be got; in other words, to deceive the consumer, and defraud him of his money.

Another instance, which concerns very much one of your neighboring States, — that is, maple syrup and maple sugar. We know that the maple tree produces a kind of syrup and sugar which is very much liked on account of certain qualities it contains, and which are not found in other natural sugars. As far as the sugar which is contained in it is concerned, it is just the same as that which grows in the sugar beet and the sugar cane, — there is no difference whatever in the sugar; but the maple sap contains an aromatic substance of a peculiarly delightful flavor, which the chemist will tell you is due to some kind of an ether or aldehyde fluid, which gives to it its value. If you should refine maple sugar or maple syrup as you do beet and sugar cane, it would be thought no more of. It is because it is a rare product, and contains these materials which are peculiar to the maple tree, that it has this additional value.

Now, what happens? Imitations of syrup are made. As far as the sugar used is concerned, or its wholesomeness, it is just as good, just as nutritious, as the maple syrup itself; but it is fraudulent in character. The object in making these imitations is not to injure humanity, but to defraud humanity, and therefore it is an adulterated article. I am told that even the farmers are not altogether free of this. I am not sparing our own profession, you see, when we follow the wrong direction. I have never seen this, because I have never been in Vermont during a maple season; but I am told that you can find around the factories there empty barrels in which brown sugar has once been contained, and that this is mixed in with the product of the maple sap. I am not saying this is true; I am told it is true; it is possible that it may be true. That is an adulteration; that is for the purpose of defrauding the consumer.

You may be interested to know that the very largest maple bush in the United States is in the city of Chicago. Of course Chicago is a large city, and contains many wild woods and swamps, and among them must be hundreds of thousands of maple trees, — that is, if you judge by the amount of "pure Vermont maple syrup" that is manufactured in that city. It is something enormous. It is a good syrup, just as good as any, just as nutritious as any, maybe; but it is a fraud, absolutely fraudulent in its character, and therefore is an adulterated article, although not injurious to health, and should be excluded from the markets if sold under the name of maple syrup.

Fortunately, we have now a law on the federal statute book which prevents the naming of a product manufactured in one State with the name of another State. It is a law which says that no food or dairy product shall be misbranded in respect to the State or Territory where it is made; and now we are compelling the Chicago proprietors of this maple business to leave the word "Vermont" off, but the law doesn't say anything about "maple," unfortunately, — they can put that on, and do. So that they no longer sell the Vermont maple syrup, as they did two years ago, but sell "Pure maple syrup." It leaves Vermont off, but has no regard for the consumer.

Now, you can see how such practices touch the farmer financially, because the proprietors of real maple syrup, the growers of the maple and those who do make real maple syrup, are brought into competition with an artificial article, which brings their product down below the price of profit. This is a direct blow to agriculture.

Again, let me refer to dairy products. You have all heard of oleomargarine. No man who has ever investigated the subject from a hygienic point of view, or in regard to the nutritious qualities of the article, can say anything against oleomargarine. It is a good, wholesome, proper food, — that is, when it is made as it should be made, and very bad when it isn't. There is nothing to be said against oleomargarine as to the matter of nutrition and of injury to health, when it is properly made. To my mind, it has the same right on the market, as any other food product, and the laws against it are unjust laws, as they make class distinction. The crime of oleomargarine is in appearing under a false name, and deceiving the consumer; that is where oleomargarine must be struck, because it is fraudulent when sold as butter. The man who sells it for butter steals your money the same as if he put his hand in your pocket, and should have the same punishment given to him; but the man who makes it and sells it as oleomargarine commits no crime whatever, as he is giving you a good article at a less price, and selling it under its own name.

Glucose is another article concerning which the farmers are interested, for many of them keep bees and make honey. Honey has a competitor, just as maple syrup has. The aroma of the flower, or the animal excretion from the bee, passes into the honey and gives it a flavor of high value, so that the sugar from the honey is worth two or three times as much as ordinary sugar, just as the maple sugar is worth more than it would be simply as sugar. And here is a fraud upon every man who makes pure honey, as well as a fraud upon the man who consumes it, when glucose is sold as honey. When sold as honey, glucose is an adulterated article; when sold as glucose, it is absolutely free of adulteration. The farmer who makes pure honey, in keeping bees, should be protected in some way against having the price of his article diminished by a competition which in itself is fraudulent in its nature.

Now, these are some of the points in a very few common articles where the farmer is financially injured by a competition with an adulterated article. But they do not stop there, — the farmer's losses do not stop with the few things I have mentioned; they extend all along the line in almost every form of adulterated food, because, whenever any cheapened food is placed upon the market at a less price than the genuine article, it is a blow to legitimate agriculture, which either produces that food directly or the raw materials from which it is made. So the farmer, I believe, is injured financially by every species of food adulteration that is practised, — every single one. He is also injured as a consumer, because the time has come now in this country when the farmer has just as good things and as many things on his table as anybody else. We are no longer compelled to subsist upon the fruits of our farms alone. We are not satisfied, when we sit down at our tables, if we do not have contributions from every country and every clime upon the table. We have coffee from Brazil and tea from Ceylon, we have marmalades from England and wine from France, and cheese from all nations; all these the farmer has upon his table. And therefore, if this system of fraudulent manufacture continues and expands, or continues as it is, the farmer is directly injured as a consumer at his own table.

For instance, how many of you use Java and Mocha coffee? I don't know how it is here, but in our part of the country everybody uses Java and Mocha coffee. Hardly anybody in Washington will have anything but that, they won't use anything else; but how many of them get a grain of Java and Mocha? Not one. Every grain of what they use is grown in Brazil, — every one. What little Mocha or Java is imported, is imported on private order. We imported last year nearly 900,000,000 pounds of coffee, — less than 4,000,000 pounds came from Java and Arabia; so you can know what proportion of the whole amount is real Java and Mocha. And this that was imported was on private order for special consumption, and was never sold on the market. And when you go to the grocer to-day, and he sells you Java and Mocha coffee, he defrauds you. He may not know it, — I don't know that he does; he ought to know it, and you ought to know it. Why should you pay 40 cents for coffee that costs 9 by the bag? I don't want to say anything about the great coffee roasters, — they are rich enough, however, to take care of themselves, — but that is not the way to buy coffee. The purest way in the world is to buy it green. You could get the very best which you buy as Java and Mocha a year ago for 5 cents a pound; this year it has gone up to 9 cents. I bought a bag the other day, and paid 9 cents, and it is the very best you can buy. We grant, of course, that the coffee dealer should make his profit; but the idea of selling coffee that costs 9 cents a pound for 40 cents is a fraud, to my mind, and should be prevented. So, when the grocer sells you coffee and tells you it is Java and Mocha, you can tell him it isn't true. This is a fraud upon the farmer, because the farmer is a large consumer of coffee. I think it is one of the best beverages, if you don't use too much of it. The way to use coffee is to roast it and grind it before it gets cold, or, if you can't do that, at least not more than two days before you use it. Coffee begins to deteriorate the moment it is roasted. I don't care how you keep it, even in an air-tight can, it begins to lose its flavor.

We consume more coffee per head than any country. England is the great tea-drinking country, drinking about nine times as much per head as we do. We are a great sugar-consuming people, over 70 pounds per head in the United States, to 8 pounds in Russia and 7 pounds in Spain. England is the only country that uses more sugar, and she doesn't consume it, but makes it into marmalades and such things, and sells it to us. We eat the sugar, and they get the credit in the market, of course.

These are some of the points where the farmer is greatly touched by the practice of adulteration. I don't need to extend these illustrations. I might mention a hundred of them, but these are sufficient for illustration.

I want to refer to some of the other evils which are equally as important in my point of view, viz., the effect upon the health. Now, your chairman was kind enough to say that I didn't exhibit any signs of having been injured by these adulterated foods, but I can give him instances where people have been injured. You know there are some people so happily constituted that they can digest anything, and therefore they are not to be taken as examples of what may happen to others. I had an application a while ago from a man who wished to be put upon my experimental table. It read like this: —

> DEAR SIR: — I would like to get a position on your table. I have a stomach that can hold anything. I have eighteen diseases. Fifteen years ago the doctors said I couldn't live five years, and I am still alive. Now, if you want a man that can eat anything, why, I am the man you want.
>
> Yours respectfully.

And I am a good deal like that myself; I have an active secretion of pepsin that can dissolve almost anything that goes into my stomach; but that isn't the case with everybody, unfortunately.

We have conducted a lot of experiments on certain young men, to determine whether or not certain things are injurious to health. This was done under the authority of Congress, and the work has now proceeded for two years; we are now in the third year of this investigation. The first year's work has been completed and the data tabulated, and we know what effects were produced upon the young men by the foods which we gave them. During this year we fed these young men, in addition to ordinary foods, borax and boracic acid, because these are substances largely used in the preservation of food. I believe Massachusetts is much interested in this, because the codfish, which you produce in this State, and which we enjoy even so far south as Washington every Sunday morning, in the form of fishballs, is largely preserved by borax or boracic acid.

We fed these young men very nearly a year with foods that contained these substances. I am not going into detail; it would take 600 pages of print to tell in detail what I am going to tell in five minutes. It produced injurious results in a great many cases, not only on one but every one of the twelve young men subjected to this experiment. The result of this work shows that borax is not a proper substance to be placed in human foods for anybody. There may be occasions when exigency arises, — when there is an absolute necessity for the use of such things. I may illustrate: England, as you know, buys her food mostly from other countries, largely from her colonies. Australia, for instance, sends large quantities of dairy products and meats to England; this is a journey of 12,000 miles. It is far better to eat food that has borax in it than to eat food which contains ptomaines, which arise from not keeping. While you don't feel any immediately noticeable effects from the one, the other makes you decidedly ill; and I prefer to eat borax, because I don't know how I would feel if I ate the other, and I don't want to take any chances. So in that case I think it is perfectly proper for the English, who have pretty good digestive organizations, any way, to use it, in order that they may get their food free of ptomaines.

For instance, I have often read of the orders which they send to this country for cured meat, such as we use here, — only we have no borax in our cured meat, as far as I know. The great packers do not put it in; after it leaves the packers, I don't know what happens to it. So when England orders a car load or boat load of meat, she orders it to be packed in borax, spread on the outside of the meat, because it preserves it. And when they order butter from Australia, they order it preserved with borax, because it will come to them sweet, and not rancid. These belong to special cases, and not to the regular cases of every day. No one should put borax in food unless the consumer himself orders it put in.

I believe in the largest personal liberty. I don't want anybody to dictate to me what I shall eat or drink, or what kind of clothing I shall wear, or what political party I shall belong to, or what creed I shall adopt; those are things I want to decide for myself. The Apostle said, "Let no man judge you as to meat or drink." That is your business; not his. Let him eat what he wants to, and you do the same.

But it is the duty of the public to prevent a man being poisoned against his knowledge and will. That is where the function of the law comes in, — not as a prohibition, but as a protection of the people. We have here to-day about two hundred people — I wish there were more — in this audience, and if any two want borax in their food, they may stand up; but the other one hundred and ninety-eight don't want it. Now, is it fair that we should all eat borax without our knowing it, in order that two should have it if they want it? It doesn't seem to me that is right. Let them prepare their own food in their own way. I say when the consumer wants his food with borax, — not poison, because borax is not a poison in any sense of the word, and the young men whom we had were not really a "poison squad," although they were known as that in the public press, — if he wants borax in his food, let him have it for his own special benefit, but don't treat the rest of it in the same way; keep it out, for it isn't necessary in this country.

Now, about codfish I can't speak; it is a delicate subject, — pretty close to the place from which it comes; but I will say this: when I was a student in Harvard University some years ago, before the days of preserving codfish with borax, I enjoyed that article of food immensely, but I have rather lost my taste for it now. It is not as good as it was in those days without borax; and you can preserve it without borax. I know when they put it in it looks awfully nice, and you don't know it is there. That is the danger of these things, — they don't reveal themselves; they have no properties of odor or taste by which you know them. You eat a piece of codfish with 8 per cent of borax, and you can't taste it; but if it is salt you are likely to know it, and you soak that salt out before you use the fish. Common salt is a preservative, too; but it is a necessity in our food, and borax is not. Common salt in excess is injurious; borax is injurious in any degree. Take all the common salt out of our food, and we wouldn't any of us live long, because digestion in the stomach takes place by means of hydrochloric acid set free from salt; and if you take the salt away there is no way of getting the acid, and one would starve to death, although with an abundance of food. But if you use too much salt you injure yourself. This is used as an argument in favor of preservatives. They say salt is injurious, and should not be used, if borax shouldn't. But that is not logical, because one is a necessity to existence, and the other is not.

The presence of any preservative in any food, which is without taste or odor so that its presence may be known, is wrong. For example, sulphites, which give the beautiful color to Hamburg steak which you buy in the market. You never saw meat so rosy and red as Hamburg steak is; and it keeps that way for weeks, if you leave it alone. Why? Because it is loaded up with sulphite of soda. Now, get your own Hamburg made, or see it made from fresh meat, and don't buy it from that which is red, because it is colored artificially, and is harmful. That substance is positively injurious to health, and therefore should be excluded from meats. The only permissible way to keep meats, aside from canning, cold storage and desiccation, is by the old-fashioned method of salt, sugar, vinegar and wood smoke. Those are all condimental substances, — every one of them. They reveal themselves. One is a food, sugar; the others are condimentals which are harmful in excess themselves, but they reveal themselves so they are not likely to be used in excess.

Another method, cold storage, is not actually to be condemned. Meat improves for a certain time in cold storage, and it is only when meat is carried too long in cold storage that it is objectionable. Canning is also a good method of preservation.

These are the ways we can preserve our meats. We don't need any chemical preservatives of any kind for our meat, our butter or our milk, for ordinary consumption in this country. If I were going to the north pole,—which I hope I never may, as this is quite cold enough for me,—and had to be gone three years, and had to carry my food with me, I might prefer to have that food treated with antiseptics of a chemical nature rather than take any chances of its being decayed, for the injury coming from those chemicals is far less to the food than that which comes from decay. The same is true of mining camps, or the army, or the navy, when far from the base of supplies. These are cases where it may be proper to use these preservatives, but not for general consumption.

I have thus briefly illustrated some of the things which I believe added to foods are injurious to health. I would not say absolutely that such things should be excluded, but I do say that people should not have those unless they want to. Go to the manufacturer and say, "You may put this material in your food, but put a label on, saying that it is there." "Oh, no," he will say, "I can't do that; nobody would buy." What is he doing, then? Deceiving the consumer,—he confesses he is. He is selling you a thing which you wouldn't buy if you knew what it was. That is fraud; that is adulteration, and it ought not to be permitted. You have a right at least to know what you are eating, and you ought to have an opportunity to know the character of what you are eating. Most intelligent people do know that certain substances are injurious to health, and they won't eat them; but there are hundreds and thousands of people who know nothing about it, — even the label means nothing to them. So it is pretty hard to say where this permission should stop, and how far it should go.

There is another point that I wish to speak about, as it interests the farmers directly. I am speaking more of a financial interest at this time. I think farmers ought to make a living just the same as anybody else. They have the same right to profit on their labor as any one else. They have a right to an open market, as the man who sells his labor has a right to an open shop. They shouldn't be compelled to come up against a false competition. A legitimate competition between farmer and farmer is all right, but a false competition is wrong, and therefore a farmer should be protected in the markets in his legitimate products.

I was talking with a member of this Board who makes cider vinegar, which we have come to consider in this country the very best vinegar that is made. I will not stop to discuss the question whether that is a just opinion, or not, but that is the opinion in the United States in regard to vinegar. In France they think wine vinegar is the best, and so different countries prefer different things. But we think the cider vinegar is the best, and it brings a higher price in the market, — a legitimate price, because it is best. Now, that a man who makes cider vinegar should be compelled to run up against a false vinegar, mistaken as cider vinegar, and selling at one-half of the price which he can afford to sell the cider vinegar for, I say is wrong. It is an outrage, and should not be permitted; it is an unjust competition. I say this without relation to the relative qualities of the vinegar. It illustrates what I had to say of the competition of farmers with foreign products.

You will be surprised to know that we are the greatest food-importing country in the world; we import more food products than any other nation. We import 900,000,000 pounds of coffee; we import 1,500,000 tons of sugar from foreign countries; and bananas and pineapples, and hundreds of things of this kind, in immense quantities; we import eggs, — and I will tell you the kind of egg we are importing, or trying to import. Two years ago Congress passed a law ordering the inspection of food imports before they entered this country, for the purpose of excluding from the United States all food products to which substances had been added injurious to health; second, to exclude from the United States all products that are misbranded in any respect, with no regard to the contents of the package or the country where they are from, — any fraudulent brand on a food product warrants its exclusion from the United States; and, in the third place, to exclude food products which are not permitted to be sold in the country from which they come, — that is, things that are not good enough for foreign countries, in our opinion, are not good enough for us, without raising any question at all with ourselves as to their value.

Now, what did we find? We found large cargoes of liquid eggs coming here. You know the value of the hen to the farmers of the United States. And we found cargo after cargo of liquid eggs coming from China! They are eggs produced in China, broken and mixed together, — you know how long eggs will keep in that condition, don't you? They don't keep very long when the shell is intact. I myself occasionally sit down to eggs which are past the voting age, almost, and with the shell unbroken. Now, if you break the shell, the process of decay is all the more rapid. As it takes sometimes four months for a cargo of eggs from China to reach here, you can imagine in what condition the eggs are when they arrive. But when you examine the eggs you find them reasonably sweet, — not exactly the thing you would want to get in an omelet, perhaps, but they are in a reasonably good state of preservation. Why? Because they are loaded down with borax. We have found as high as 4 pounds of borax to 100 pounds of liquid egg, — in dry matter about one-quarter as much borax as dry egg. In that way they are able to ship the egg to this country and sell it at a less price than the farmer can sell fresh eggs. It isn't just to the farmer; it isn't just to the consumer; it isn't a fit product to eat. Of course the importers set up a howl that we are interfering with legitimate trade; but we are not, — we are simply excluding from this country what Congress says we shall exclude.

What happened after that? The Secretary of the Treasury called our attention to an invoice of a chemical compound. It was not invoiced as liquid egg, which it really was, because we would inspect that, as we had the other. This came in as a chemical compound, but the Secretary of the Treasury called our attention to it, and we found it before it got on shore.

And that is not the only thing that the farmers come in contact with. We have farmers in this country outside of Massachusetts, in California, for instance, and they grow the best olive oil you can find in the United States. It brings a high price in the market, on its merits. They have good imported oil, too, but this California olive oil is in great demand. And we found that our California olive oil makers were not only brought into competition with domestic adulterated olive oil, — made largely of cottonseed oil, — but they were brought into competition with a foreign article imported as olive oil which wasn't olive oil at all. Under the law of correct labelling we exclude these oils. If we can find a cargo coming into this country as California olive oil, which isn't California olive oil, we exclude it because it is misbranded. This is in the interest of the California olive oil producer, as well as the consumer everywhere. So in this we are helping the farmer in California by saving him from unjust competition with this foreign article.

What happens next? We find a cargo of oil coming from a foreign country, and we are surprised to find it marked in the name of some mission in California, with a picture of it on the label, which sets forth the merits of the olive oil, — the more label you find on an olive bottle, the more fraud you will find, as a rule. What was the object of that? These importers knew that the California olive oil is valued because of its fine quality, and so used this label on their product. It was a pure olive oil, — it wasn't an adulterated article, — but it was a foreign article labelled "Pure California olive oil," and therefore is excluded because it is falsely branded. This was an attempt to evade the law, and bring the California producer again into unfair competition.

We make wines in this country, in New York and Ohio, and especially in California. Now, I don't know what your views are in regard to wine drinking, — that is something I have nothing to do with. I like good wine myself, and drink it when I can get it, especially if somebody else pays for it; but when I am drinking wine, I want to know I am drinking wine. That is a reasonable view, that any one might have. I don't want to drink any concoction, I want the real thing. And we find imported into this country large quantities of wine which is not of that quality. We find wine which contains enough sulphurous acid almost to make you ill, in a single case, put there for the purpose of preserving the wine.

A short time ago I went out to dinner — I have a few friends who happen to be wealthy, and I wish I had more, because they always give good dinners, and they invite me; it seems I am a professional diner. The gentleman said to me, "My wife has been drinking wine, and it always makes her ill; I wonder what is the trouble with it?" He sent down in the cellar and got a bottle. I told him I thought it impossible that the wine made her ill. I opened the bottle, and I knew at once what the matter was. Instead of wine, he had a solution of sulphurous acid. The fumes of burning sulphur are familiar to you all. Instead of the beautiful odor of wine, we got a sulphurous odor. It wasn't difficult to tell in this case. But we say the wine shouldn't be made with this injurious substance, detrimental to the health, and it shouldn't be imported into this country, not only in justice to our consumers, but in justice to our farmers who grow grapes and make wine therefrom. They should have protection against a fictitious or injurious article imported from a foreign country.

Another article is sausage. We have Deerfoot sausage in this country, and a very good sausage it is, too; and many other kinds; and we used to import a great deal of sausage. We found that Germany was sending us sausage which they wouldn't allow to be consumed at home, but according to law it can't come in now, for it contains borax. The manufacturer makes it without borax, but when he sends it across the water he puts borax in it, for us. "They will eat it," he says. And we did, until two years ago, when this law went into effect, after which event all sausage dressed with borax has been excluded. There was one boat load sent back to Germany, which, when it reached Germany, wasn't allowed to enter, because they have a law that no piece of meat shall enter Germany that weighs less than eight pounds. This meat, naturally, did not weigh that, and is still sailing the seas over, like the "Flying Dutchman," for aught I know.

This illustrates some of the ways in which we are trying to help the farmer, as well as the consumer, by freeing them from all unjust competition. And it seems to me this law is a wise one. It certainly has had the most salutary results so far, and we wish it might be extended to domestic manufactures, but there we have a very great difficulty.

It is strange how State legislators are always ready to hear essays and addresses on pure food, and are so ready to legislate along those lines, when it seems almost impossible to get through Congress any law which applies to domestic adulteration of food under federal control. Most of the States have excellent laws and they execute them; but there is no federal law regulating interstate commerce, and it is very difficult for a State to protect itself against food adulteration practised in other States.

If we passed a law to inspect food products and to regulate interstate commerce in them as we now regulate foreign foods, we could in a short space of time do away with food adulteration as it is practised generally to-day. No one can tell, I believe, the real amount of injury which the eating of adulterated food is producing. Although the adulterations are not poisonous, yet they produce an effect which is detrimental to health, and are the more dangerous because they are insidious. A little borax, a little sulphurous acid, the coloring that is used, a dozen different dyes every day, —all these things must finally leave some impress, especially upon a delicate organization. They may not affect me, or the majority of men who are able to bear them; but they will affect those naturally predisposed to disease, or having a tendency to disease, so enervating the system that other forms of disease will fasten upon it, which are not due to kind of foods eaten. It tends to weaken the body and weaken the efforts which it will make to reject the ordinary forms of disease to which it is subject. So I think that it is due, especially to that class of our people who have a good deal of trouble with digestion, and to the infants and to the invalids, that they should be protected by law from insidious dangers to which they are exposed.

You may think, practically, that we have no foods except those which are adulterated. Of course, in an address of this kind it is only natural to dwell upon those things which illustrate the facts you bring forth; but I would not have you believe, by any means, that the great mass of foods which we eat are adulterated in any respect at all.

There is no such thing, I believe, as sand in the sugar. I have examined thousands of pounds of white sugar, and never discovered any sand. I think that is an old joke without any basis in the United States. And as to flour, I don't think you need to fear meeting your death in that respect. Flour and sugar, the two staple foods, may be regarded as unadulterated. All foods are not adulterated. Many are free of adulteration, although, unfortunately, all are not so.

Butter, — what shall I say about butter? I am addressing a large body of men interested in the dairy business, and I wouldn't like to say what I think of butter. I am one of those unfortunate people who are opposed to the coloring of butter, and I expect I shall always be. If nature doesn't color it, I will take it as nature makes it, any way; I don't think we can improve on nature.

Mr. H. S. PERHAM (of Chelmsford). I would like Dr. Wiley to tell us if there are any preservatives that can be used which are not harmful to health. He did not speak of benzoate of soda. I would like to inquire if that is harmful as well as those he mentioned.

Dr. WILEY. As a result of our own experiments, although we haven't the data tabulated from feeding young men on benzoic acid, as we did last winter, the data not having been compiled and studied in such a way as to give any definite answer, I will say that visibly the benzoate of soda was not injurious, as far as any outward effect is concerned. But I believe all preservatives are injurious, — a theoretical reason, but based on large experience. The preservative is only effective when it can control bacterial action. It takes just as much action to kill bacteria, whether with a hammer or borax or salicylic acid; and the preservative is injurious to health, because digestion is a fermentation just as much as making vinegar of cider or making alcohol out of sugar is a fermenting process. Whenever benzoate of soda is given in such quantities as to prohibit action, it must be injurious to health. And that is true of anything whatever.

QUESTION. Are the cereals that we all eat adulterated, — the breakfast foods?

Dr. WILEY. I never examined the cereal foods for adulteration at all. I don't think they are adulterated. I have heard some wild statements in regard to arsenic and morphia, and so forth, in breakfast foods, but I think they are wrong. There would be no object in putting them in; they are not preservative articles. I don't think there is any adulteration, as far as I have ever seen, in any of the cereal foods, so called.

The CHAIR. I hope the ladies will show the doctor that they know how to roast coffee, before he leaves us, that he may carry something back to remember Framingham people by, in his old bachelor home. Won't the ladies take part in this catechising? Remember, it is open to any one.

Mrs. H. G. WORTH (of Nantucket). I shall have to admit that I don't know how. I was in hopes he would tell us.

Dr. WILEY. I would like to tell the ladies how, if they would like to know. I am not exactly a professional chef, although a good chef could earn more money as a cook in New York, five or ten times over, than I can in Washington. But I am not devoted to money making; if I were, I would be buying stocks to-day. Sift the coffee through sieves until you get grains of the same size. You never can roast coffee if you have big grains and little in the same lump. If you roast the big ones, you will burn the little ones; and if you roast the little ones, the big ones will be raw. That is the first step. Then you must have a way of applying heat. One good way is to shake the pan, but that is a pretty strenuous operation. These little rotating roasters that they roast peanuts and chestnuts in are very excellent. That is what I use in my house. They accuse me of being a bachelor, but I keep house and supervise my own cooking for the "poison squad," and sometimes invite my friends. Then you want to give a good roast, a little more than brown. Coffee when made right ought to be nearly black. If you don't roast to that point, you don't get quite the flavor of the coffee. Have every grain alike; that is the beauty of it. The great mistake generally made in coffee roasting is trying to roast grains of different sizes at the same time. That is the whole story, — to apply the heat evenly to grains of the same size.

QUESTION. What grade of coffee do you call for when you want the raw coffee?

Dr. WILEY. Nearly all our coffee comes from Brazil. A little comes from other places, such as Porto Rico, but that is a very small part; probably 80 per cent comes from Brazil. No. 1 is the highest grade, I believe. I am not sure about that, however; I don't know which way they run, but they have these different grades. They are all different prices. The best grade sells now for 11 cents, the lower grades will sell for less. The low grade did sell for 3 cents a short time ago, and the high as low as 7, but now they are up a little. The kind that is sold for Mocha and Java is the highest-grade coffee. The coffee tree was imported from Arabia and India to Brazil. Don't think I mean the coffee sold for Java and Mocha is not good coffee, — I haven't the least notion of saying that. I say it isn't Java and Mocha, and therefore should not bring the price it does. The grains are rounder and plumper than the other grains. You go to any coffee dealer in Boston, and get him to show them. If you get it at wholesale, you will get it at the price I pay now. I think I paid 11 cents per pound by the bag.

The CHAIR. We have in the audience one of the oldest of the former members of the Board of Agriculture, — a man whom every one who knows him respects and loves. I know it would do you good to see his face and hear him speak. Mr. Hadwen, will you step forward and face the audience and the Board, and speak to them?

Mr. O. B. HADWEN (of Worcester). I feel very much embarrassed and I also feel very much flattered at being called upon on this occasion. I always felt it an honor to attend the meetings of the Board of Agriculture of Massachusetts. I had the good fortune to be for twelve years one of its members, but I believe to-day there are but two persons living who were on the Board when I first became a member.

I appear before you as one who has a great fondness for agriculture, I might say, in all its phases that are adapted to the Commonwealth, and for seventy years have engaged in its calling. I have been very much delighted to-day, as you all have, in listening to this lecture. We have never had the privilege before of listening to such an able lecture on the same subject. I most heartily concur, so far as I am able, in the sentiments that have been expressed. I belong to a club whence this Board of Agriculture emanated, that has been in existence since 1840. One of the members of the club grows in the western portion of the country 20,000 acres of wheat every season, and he stated a while ago that in less than fifty years the bread basket would be empty. He meant us to gather from that that we had got to depend more upon our own resources in this Commonwealth than we have been doing; that we should have to change our modes of agriculture, and go back to the agriculture which was pursued in earlier times, and raise grains for our own sustenance. This will undoubtedly prove true. It is well known that this Board was organized to stimulate the agriculture of the State, — which it has done, — because the prosperity of the State depends so largely upon cheap and economical living for the masses. We all know that our acres feel the influence of this Board, have grown more productive, are managed with more skill; and still they are not managed more than half as well as they should be. Our pastures are practically neglected. We have not come to the idea that our pastures should receive the same care as the other portions of the farm, but it is not many years before it will prove a necessity. Mr. Chairman, I can't go into all the different phases of agriculture which I have pursued for the last seventy years, but I have taken a great deal of pleasure in the calling, and perhaps have tried to make the old adage true, — of making two blades of grass grow where but one grew before.

Mr. **Perham.** We can scarcely enter a car anywhere in eastern Massachusetts without seeing an advertisement reading something in this way, perhaps: "Don't use coffee; use food coffee." Will the doctor tell us whether he has examined what is called "Postum Food Koffee," and, if so, what it consists of?

Dr. **Wiley.** I never have made any examination of "Postum Food Koffee," and do not know what it is made of, further than it is claimed to be in part a cereal. Of course if people don't want to use coffee, they needn't do so, and the manufacturers have a perfect right to advise them not to. I would criticise this advertisement in this respect, — in the use of the word "coffee." Coffee means a certain definite product. An ordinary cereal, if it bears the word "coffee," is fraudulent, — has a fraudulent name. It isn't coffee; it is a substitution for coffee, maybe, but it isn't coffee. And if this product contains coffee as an ingredient, then it is again fraudulent, because it advises the people not to use coffee, when they are using it under another name. But I don't suppose it does. I suppose the word "coffee" is used there simply to indicate that this can be used as a kind of beverage in place of coffee. Now, if coffee means nothing but being hot and being brown, why that probably is both. But coffee has specific qualities; it has tannin, and caramel, and an alkaloid which is injurious when used to excess; and the oil and the aroma which is produced by the roasting of the coffee all combine to give coffee its properties, and people who are injured by these substances ought not to use them. I have no doubt many people are injured by drinking strong coffee. I know if I drink a lot of strong coffee, for instance, at a reception at night, it keeps me awake. That is an injury, and I oughtn't to do it; but I do it, and take the consequences myself. It doesn't hurt you, — unless I deprive you of my presence. But I deplore the word coffee being used upon an article advertised as a substitute for coffee, which really contains coffee. That is the only objection I have.

Mr. PERHAM. I was led to ask about this matter, and a student in the Institute of Technology, taking a course of chemistry in the past half a dozen years, told me that they had made there repeated analyses of the "Postum Food Koffee," and found it more than half coffee, and yet it is advertised as a food coffee not injurious to health.

Dr. WILEY. I would like to say, Mr. Chairman, if that is the case, if those people are warning people not to drink coffee, and then selling coffee under another name, it is a fraud, — a food adulteration, pure and simple.

Mr. JOHN BURSLEY (of West Barnstable). I move at this time, in behalf of the Board of Agriculture, that our thanks as a Board be extended to the citizens of South Framingham, the Board of Trade of South Framingham, and especially to our associates on the Board, Mr. Damon and Mr. Bowditch, for the most generous hospitality and entertainment accorded our members in all particulars.

The motion was seconded and carried.

Mr. P. M. HARWOOD (of Barre). It isn't every day that we have a man like Dr. Wiley with us, and I think we ought to get all the information we can. I am sure there are some in the audience here who would like to know the effect of formaldehyde upon food; and as a matter of general information of the adulteration of liquors other than wines, like whiskey and brandy, or anything of that kind, — what adulterations, if any, exist, and whether or not they are injurious.

Dr. Wiley. I have just been feeding a class of twelve young men on formaldehyde for twelve weeks. They were just coming off their food as I came away, and of course we haven't had time to tabulate the data, but I will say that each showed visible signs of very severe distress. I left four of them in bed, and the others wanted to go. Of course we fed up to as much as one part in five thousand, which is more than is ordinarily used in food; but we began with a much smaller quantity. But the question is not how little of a dangerous article you can use in food, — the courts have held that you shall not put any in; and adding a little of it is no excuse, — just as the law says you shall not steal; it is no excuse if you steal only a penny. If the substance is injurious to health of itself, under the decisions of the Supreme Court of Pennsylvania it cannot be added in any quantity at all. It would be different if the law said, "in quantities which will make that food unwholesome," — which would be an unfortunate law, because you never could convict a person, for the sample itself would be already consumed before the proof would be forthcoming.

Now, we have positive proof, without going to the trouble of tabulating the data, that formaldehyde is injurious to health. It produced a very marked lowering of the pulse, depression of the temperature, showing a specific action on the heart. In four cases out of the twelve it was accompanied by pains of a very severe nature, in two cases nausea and vomiting, and in all cases preventing their taking the food which they were compelled to take under their pledge, whether they wanted it or not. On the whole, we decided it was very injurious to health. We did not feed it to them excessively, but one part in five thousand.

In regard to liquors, that is a delicate question. I read an advertisement the other day, written by an old lady one hundred and six years old, — that is, it purported to be written by a lady one hundred and six years old, — living in a town where I used to live, in Indiana, saying: "I have just passed my one hundred and sixth birthday, and am in perfect health; and I attribute my perfect health, in body and mind, to the fact that every day for sixty years I have taken a certain quantity of whiskey. Nancy Taggs." I wrote to a personal friend of mine, and received this reply: "There is an old lady by the name of Nancy Taggs in the almshouse, and of course they furnish whiskey to the inmates." He found this lady reasonably healthy in body and mind, and not knowing her exact age; of course women don't tell that, even at that advanced period of life. When he asked her about the kind of whiskey she had been drinking, she seemed very much interested. She said, "I never touched a drop of whiskey in my life, of any kind."

Since then I found two other advertisements, one one hundred and three and one one hundred and five years old, similar to that, in different localities, of the same brand of whiskey. I have written for information in regard to those, which will be probably of the same kind. The ways of the advertiser are devious.

This country is being crushed by the press, in their publishing stories and advertisements absolutely fraudulent in character. Since the 1st of January, through our instigation, the post office has issued fraud orders against over fifty of these advertisements, prohibiting circulation.

Just the other day my name was used in an advertisement fraudulently. When I wrote to the firm, they told me they would attend to their affairs, and allow me to attend to mine. Whereupon I issued a fraud order against them, and cited this man to appear before the authorities, which he did last Friday morning, and after a hearing, lasting about ten minutes, the fraud order was issued, and all papers and circulars hereafter excluded from the mails. They were making me say a thing I never said, and wouldn't be implicated as saying.

But the distilled liquors which we drink are something awful, — that is, to drink them. I don't suppose any are drunk here, but those who do drink them find that the old-fashioned whiskey has disappeared practically from the trade. If a physician orders whiskey for you as his patient, you don't get whiskey; it never has been whiskey, and never will be, — you get the thing that is called whiskey.

I am not saying anything about how wholesome it is, compared to whiskey, because I know even whiskey is none too wholesome; but it isn't whiskey, and therefore it is fraudulent. You see a big advertisement running, of a certain kind of whiskey; that isn't whiskey, — it never was. It is a beverage, to be sure, made under the laws of the United States, unfortunately, which have countenanced just that sort of thing under what is called the "rectifying law." A man can take out a license, and rectify. What does that mean? I think it means to make something better, to straighten out; and when applied to whiskey, it means the adulterated substances are removed. But it doesn't mean that at all. He can take out the oil that is in it and put in what he pleases, — providing he pays the tax. And then he can sell it under whatever name he pleases, as whiskey, raw whiskey or any other whiskey. That is rectified whiskey, or blended whiskey, as it is called. Blended whiskey is sold everywhere to-day; and you can't go to a bar in Boston, or any other place where whiskey is sold, and get any other kind but that. I will correct myself. There is one place where you can get pure whiskey. You can go to a government bonded warehouse and get it out of bond. That is stuff that has been put in there, and never manipulated. That is straight whiskey.

Mrs. Worth. I simply want to thank the doctor for his address, from the standpoint of a housekeeper. I think this is a subject that housekeepers are, or should be, interested in. They are largely responsible for the health of the family, and every one should feel very grateful for any knowledge on this subject, and to those who are studying and working for the best interests of humanity in this respect.

Dr. Wiley. I am glad to have this word of commendation. And I would like to say a thing that is patent to everybody, — if the women of this country would pay more attention to foods and less to voting, they would do the most good. I am not opposed to woman's suffrage, by any means, but I would like to see an improvement in the kitchens of our families.

The **Chair**. The time has now arrived when we must call this meeting closed.

The meeting then adjourned *sine die.*

In the afternoon members of the Board of Agriculture and many others attending the meeting visited, on invitation, "Millwood Farm," in Framingham, where they were shown every courtesy by its owner, Mr. N. I. Bowditch, a member of the Board.

ANNUAL MEETING

OF THE

BOARD OF AGRICULTURE

AT

BOSTON.

JANUARY 10 AND 11, 1905.

ANNUAL MEETING.

In accordance with the provisions of chapter IV. of the by-laws, the Board met at the office of the secretary, in Boston, on Tuesday, Jan. 10, 1905, at 11 o'clock A.M., it being the Tuesday preceding the second Wednesday of January. The Board was called to order by Second Vice-President AUGUSTUS PRATT.

Present: Messrs. Akerman, Allen, Anderson, Appleton, Bradway, Brewster, Bursley, Burt, Damon, Danforth, A. Ellsworth, J. L. Ellsworth, Gurney, Hersey, Jewett, Kilbourn, Lane, Leach, Mason, Nye, Paige, Perham, Peters, Pratt, Reed, Richardson, Ross, Sessions, Shaylor, Smith, Turner, Wellington and Worth.

Records of special meetings of the year read and approved.

The secretary read his annual report, which was accepted by unanimous vote.

First Vice-President WM. R. SESSIONS, coming in, took the chair.

Reports of committees being in order, the committee on agricultural societies, by Mr. Kilbourn, chairman, presented a written report, which was accepted and adopted.

The report of the Dairy Bureau was read by the general agent, Mr. Harwood, and was accepted and adopted.

The committee on Massachusetts Agricultural College, by Mr. Bursley, chairman, presented a written report, which was accepted and adopted as the report of the Board of Overseers to the Legislature.

The committee on experiments and station work, by Mr. Turner, presented a written report, which was accepted and adopted.

The committee on institutes and public meetings, by Mr. Hersey, chairman, presented a written report, which was accepted and adopted.

The committee on forestry, roads and roadside improvements, by Mr. Appleton, presented a written report, which was accepted and adopted.

The committee on domestic animals and sanitation was excused from making a report, as the subject matter it would cover would be found in the report of the chief of the Cattle Bureau.

State Nursery Inspector H. T. Fernald read his third annual report, which was accepted and adopted; and the recommendations concerning fumigation contained therein were referred to the committee on gypsy moth, insects and birds.

At 12.50 o'clock the Board adjourned to 2 P.M.

The Board was called to order by Mr. SESSIONS, at 2 P.M.

The State Forester, Mr. Akerman, presented a verbal abstract of his report to the Legislature.

An abstract of the reports of inspectors of fairs, prepared by direction of the committee on agricultural societies, was read and accepted.

Voted, That the secretary be instructed to appear before the committees of the Legislature in support of the petition of the Massachusetts Horticultural Society concerning procedure in choosing certain officers.

The reports of the inspectors of the fairs of the Blackstone Valley and Bristol County agricultural societies were called up and read, which, after discussion, were accepted.

Voted, on motion of Mr. Kilbourn, That the bounty of the Bristol County Agricultural Society be withheld, and that the secretary be instructed to notify the Treasurer of the Commonwealth of the action of the Board, and that said secretary withhold his approval of the bounty of said society.

The charge against the society was pool selling on its grounds during its annual fair, and the action of the Board was taken under Revised Laws, chapter 124, sections 4 and 8, the vote being by the necessary two-thirds.

The irregularity of the Blackstone Valley Agricultural Society, being minor in character, was passed over, by vote of the Board.

The sixth semiannual report of the chief of the Cattle Bureau was presented by Dr. Peters, who read an abstract of the same, and the report was accepted.

At 4.45 o'clock the Board adjourned to 10 A.M., Wednesday.

SECOND DAY.

The Board was called to order by First Vice-President SESSIONS, at 10.10 A.M.

Present: Messrs. Akerman, Allen, Anderson, Appleton, Bradway, Bursley, Burt, Damon, Danforth, Douglas, A. Ellsworth, J. L. Ellsworth, Hersey, Jewett, Kilbourn, Lane, Leach, Mason, Nye, Paige, Pease, Perham, Peters, Porter, Pratt, Reed, Richardson, Ross, Sessions, Shaylor, Turner, Wellington, Williams and Worth.

The records of the first day were read and approved.

The executive committee, as committee on credentials, by Mr. Kilbourn, chairman, reported the list of qualified members of the Board for 1905. The newly constituted members are as follows: —

At large, appointed by the Governor, Hon. Wm. R. Sessions of Springfield.

Elected from the —

Bristol County Agricultural Society, William A. Lane of Norton.
Deerfield Valley, E. P. Williams of Ashfield.
Essex, John M. Danforth of Lynnfield.
Highland, Henry S. Pease of Middlefield.
Hillside, Ralph M. Porter of Cummington.
Middlesex South, Isaac Damon of Wayland.
Plymouth County, Augustus Pratt of North Middleborough.
Worcester, Walter D. Ross of Worcester.
Worcester County West, J. Harding Allen of Barre.

The report of the committee on credentials was accepted and adopted.

Election of officers being in order, the chairman declared His Excellency WILLIAM L. DOUGLAS president of the Board (by a by-law of the Board the Governor is *ex officio* president).

Further elections by ballot resulted as follows: —

First Vice-President, Hon. WILLIAM R. SESSIONS of Springfield.

Second Vice-President, Mr. AUGUSTUS PRATT of North Middleborough.

Secretary, Mr. J. LEWIS ELLSWORTH of Worcester.

General Agent of the Dairy Bureau, Mr. PETER M. HARWOOD of Barre.

State Nursery Inspector, Dr. HENRY T. FERNALD of Amherst.

Election of specialists being in order, ballots were taken, and the elections resulted as follows: —

Chemist, Dr. C. A. GOESSMANN of Amherst.*
Entomologist, Prof. C. H. FERNALD of Amherst.*
Botanist, Dr. GEO. E. STONE of Amherst.*
Pomologist, Prof. F. A. WAUGH of Amherst.*
Veterinarian, Prof. JAMES B. PAIGE of Amherst.*
Engineer, WILLIAM WHEELER of Concord.
Ornithologist, EDWARD HOWE FORBUSH of Wareham.

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* Massachusetts Agricultural College.

The secretary appointed his first clerk, Mr. F. H. Fowler, librarian for the ensuing year.

The Chair announced the standing committees as follows (the secretary is, by rule of the Board, a member *ex officio* of each of the standing committees) : —

Executive committee: Messrs. W. A. Kilbourn of South Lancaster, John Bursley of West Barnstable, Wm. H. Spooner of Boston, Francis H. Appleton of Peabody, Augustus Pratt of North Middleborough, C. D. Richardson of West Brookfield, Edmund Hersey of Hingham, Henry S. Perham of Chelmsford.

Committee on agricultural societies: Messrs. W. A. Kilbourn of South Lancaster, Q. L. Reed of South Weymouth, O. E. Bradway of Monson, J. Harding Allen of Barre, J. F. Burt of Easthampton.

Committee on domestic animals and sanitation: Messrs. Henry S. Perham of Chelmsford, Johnson Whiting of West Tisbury, John S. Anderson of Shelburne, Wm. A. Lane of Norton, Henry E. Paige of Amherst.

Committee on gypsy moth, insects and birds: Messrs. Augustus Pratt of North Middleborough, J. M. Danforth of Lynnfield, W. C. Jewett of Worcester, H. H. Leach of North Brookfield, Walter D. Ross of Worcester.

Committee on Dairy Bureau and agricultural products: Messrs. C. D. Richardson of West Brookfield, J. M. Danforth of Lynnfield, Henry E. Paige of Amherst, W. M. Wellington of Oxford, S. B. Taft of Uxbridge.

Committee on Massachusetts Agricultural College: Messrs. John Bursley of West Barnstable, W. C. Jewett of Worcester, Charles H. Shaylor of Lee, Isaac Damon of Wayland, A. H. Nye of Blandford.

Committee on experiments and station work: Messrs. Wm. H. Spooner of Boston, N. I. Bowditch of Framingham, H. A. Turner of Norwell, Ralph M. Porter of Cummington, E. P. Williams of Ashfield.

Committee on forestry, roads and roadside improvements: Messrs. Francis H. Appleton of Peabody, H. A. Turner of Norwell, H. G. Worth of Nantucket, J. J. Mason of Amesbury, Henry S. Pease of Middlefield.

Committee on institutes and public meetings: Messrs. Edmund Hersey of Hingham, H. H. Goodell of Amherst, H. S. Perham of Chelmsford, Wm. R. Sessions of Springfield, Albert Ellsworth of Athol.

These appointments were approved by vote of the Board.

The ornithologist to the Board, Mr. Forbush, spoke in reference to the advisability of preparing and publishing a special report, in book form, on the birds of the Commonwealth, economically considered.

Voted, That the Board approves of the suggestion of its ornithologist, and recommends that measures be taken to bring the matter to the attention of the Legislature.

Voted, further, That the chairman of the committee on gypsy moth, insects and birds, the chairman of the committee on forestry, roads and roadside improvements, and the secretary of the Board, be a committee to take the matter in charge.

Special assignments being in order, the request of the Worcester Agricultural Society for the approval by the Board of Agriculture of its vote, passed at a meeting of the society held on Nov. 29, 1904, "That a committee of three be appointed, with power to sell and convey the land shown by plan submitted by the Norton Emery Wheel Company at a price not less than $2,000," was considered.

The delegate of the society was present, and stated the reasons for the sale. It appearing that the meeting at which the vote was passed was legally called and held, that the vote was by the necessary two-thirds, that the request for approval had been properly advertised, and no person appearing in opposition to the request, it was

Voted, To approve the said vote of the said Worcester Agricultural Society, in accordance with the provisions of chapter 124 of the Revised Laws.

The request of the Bristol County Agricultural Society for the approval by the Board of Agriculture of its vote, passed at a meeting held on Nov. 26, 1904, "That the directors be authorized to sell the real estate and personal property of the society for an amount not less than $20,000, and to execute sufficient deeds, bill of sale and other papers necessary to so transfer its property," being in order, the matter was considered.

The delegate of the society was present, and stated the reasons for the sale. It appearing that the law had been fully complied with, and no person appearing in opposition to the request, it was

Voted, To approve the said vote of the said Bristol County Agricultural Society, in accordance with the provisions of chapter 124 of the Revised Laws.

His Excellency the Governor, coming in, was presented to the Board, but declined to take the chair.

The committee on gypsy moth, insects and birds, to whom was referred the report of the State Nursery Inspector, reported recommending that he be requested to enforce the nursery inspection law.

Voted, To accept and adopt the report of the committee.

The committee on institutes and public meetings, by Mr. Hersey, chairman, reported that an invitation had been received from the Eastern Hampden Agricultural Society to hold the next public winter meeting of the Board at Palmer, and one from the Worcester Agricultural Society to hold it at Worcester, but without recommendations.

After discussion, ballots were taken, and the Board selected Palmer as the place for holding its next public winter meeting. Date of meeting, Tuesday–Thursday, Dec. 5–7, 1905.

The Chair appointed, as a local committee of arrangements for this meeting, to act with the committee on institutes and public meetings, Messrs. Bradway, Leach, Richardson, Paige and Sessions, which appointments were confirmed by vote of the Board.

The committee on agricultural societies, by Mr. Kilbourn, chairman, reported requests of certain societies for change of date for holding fairs. After consideration, it was

Voted, That the date for the commencement of the fair of the Blackstone Valley Agricultural Society be changed to the third Friday after the first Monday in September; that of the Hampshire Agricultural Society to the third Tuesday after the first Monday in September; and that of the Weymouth Agricultural and Industrial Society to the Friday preceding the first Monday in September.

Voted, That the request of the Bristol County Agricultural Society for dates of September 4, 5 and 6, or the same dates as last year, be referred to the executive committee, with full power.

At 12.40 o'clock the Board adjourned to 1.30 P.M.

The Board was called to order by Secretary Ellsworth, at 1.45 o'clock.

Mr. Kilbourn, for the committee on agricultural societies, reported the assignment of inspectors, as follows: —

Amesbury and Salisbury, at Amesbury, September 12, 13 and 14,	H. H. Leach.
Barnstable County, at Barnstable, August 29, 30 and 31,	W. M. Wellington.
Blackstone Valley, at Uxbridge, September 22 and 23,	C. D. Richardson.
Bristol County, at Taunton, September 26, 27 and 28,	W. C. Jewett.
Deerfield Valley, at Charlemont, September 14 and 15,	C. H. Shaylor.
Eastern Hampden, at Palmer, October 6 and 7,	W. A. Lane.
Essex, at Peabody, September 19, 20 and 21,	S. B. Taft.
Franklin County, at Greenfield, September 20 and 21,	H. G. Worth.
Hampshire, at Amherst, September 19 and 20,	E. P. Williams.
Hampshire, Franklin and Hampden, at Northampton, October 4 and 5,	J. H. Allen.
Highland, at Middlefield, September 6 and 7,	A. H. Nye.
Hillside, at Cummington, September 26 and 27,	J. S. Anderson.
Hingham, at Hingham, September 26 and 27,	W. H. Spooner.

Hoosac Valley, at North Adams, September 22 and 23,	Wm. R. Sessions.
Housatonic, at Great Barrington, September 27 and 28,	A. Pratt.
Marshfield, at Marshfield, August 23, 24 and 25,	A. Ellsworth.
Martha's Vineyard, at West Tisbury, September 19 and 20,	W. D. Ross.
Massachusetts Horticultural, at Boston, September 14, 15, 16 and 17,	F. H. Appleton.
Middlesex North, at Lowell, September 14, 15 and 16,	R. M. Porter.
Middlesex South, at Framingham, September 19 and 20,	J. Bursley.
Nantucket, at Nantucket, August 23 and 24,	J. M. Burt.
Oxford, at Oxford, September 7 and 8,	H. S. Perham.
Plymouth County, at Bridgewater, September 13 and 14,	H. A. Turner.
Spencer, at Spencer, September 21 and 22,	H. S. Pease.
Union, at Blandford, September 13 and 14,	Q. L. Reed.
Weymouth, at South Weymouth, September 1, 2 and 4,	I. Damon.
Worcester, at Worcester, September 4, 5, 6 and 7,	J. J. Mason.
Worcester East, at Clinton, September 13, 14 and 15,	O. E. Bradway.
Worcester Northwest, at Athol, September 4 and 5,	J. M. Danforth.
Worcester South, at Sturbridge, September 14 and 15,	W. A. Kilbourn.
Worcester County West, at Barre, September 28 and 29,	H. E. Paige.

The report of the committee was accepted and adopted.

Second Vice-President Pratt, coming in, took the chair.

Voted, That the Chair appoint a legislative committee of five.

The Chair appointed Messrs. Kilbourn, Pratt, Spooner, Bursley and Ross, which appointments were confirmed by vote of the Board.

Voted, That the First Vice-President and the secretary be added to the legislative committee.

The secretary reported on the delinquencies of certain societies in failing to comply with the law and the regulations of the Board in sending in their annual returns.

Voted, To refer the delinquencies to the executive committee, with power to act.

Voted, That the arrangements for the summer meeting of the Board be left in the hands of the secretary, with power to act.

The meeting was then dissolved.

J. LEWIS ELLSWORTH,
Secretary.

REPORT OF COMMITTEE ON AGRICULTURAL SOCIETIES.

[Read and accepted at the Annual Meeting, Jan. 10, 1905.]

At a meeting of the committee held at Framingham the inspectors' reports were read and considered, and those of the Bristol County and Blackstone Valley were by vote referred to the full Board for action at the annual meeting in January.

The reports of other inspectors showed that the societies had complied with the laws and the regulations of the Board, and generally held successful and attractive fairs, awarding the premiums and conducting the exhibitions with credit to themselves and with profit to the people attending; that there was considerable difference in the methods used and in the kind of exhibition, being the result of local conditions.

In some societies, cattle, sheep and swine were the main attractions; in others these were wanting, and the whole exhibition was for flowers, vegetables and horticultural products. In many societies the cattle were given the first day and the horses the second day. In all the fairs it was the purpose of the officers to carry on the exhibitions in the spirit and intent of the law under which they are organized.

In holding institutes, improved attendance is shown by reports made to the secretary of the Board, and it is believed to be due to better attention to this one of the conditions for receiving the State bounty.

Respectfully submitted,

WILLIAM A. KILBOURN.
O. E. BRADWAY.
QUINCY L. REED.
J. F. BURT.

REPORT OF COMMITTEE ON EXPERIMENTS AND STATION WORK.

[Read and accepted at the Annual Meeting, Jan. 10, 1905.]

The value of the station work is more evident from year to year in its various experiments. Plant diseases are on the increase, caused perhaps in a measure by the modern intense system of culture. Insect pests are rapidly multiplying, and, as so little is known of the best remedies and the practical methods of application, these are live questions that every cultivator must meet sooner or later, and without the proper training or time for experiment.

In plants, remedies are needed for the rust on the hollyhock and gladiolus and the rot in iris, etc.; and there seems to be no department of agriculture that needs improvement more than fruit culture. There are many apple orchards scattered through the State which have been neglected, and might be brought into fruitful condition if properly treated. What better work can the station do than to select a neglected orchard in some accessible place, properly prune the trees, spray and fertilize them, as an object lesson to owners and others, and, if possible, bring the culture up to a higher plane?

Perhaps the farmer has a valid excuse for not giving more careful attention to his apple crop, when we consider how little control of sales he has, being charged a fixed price per barrel for selling by the commission merchant, without regard to the amount received, while to this must be added the freight and city carting. It would seem more just to the farmer to make a percentage commission on sales.

The farmer who has 100 barrels of apples to send to market first spends $35 for empty barrels, for which he never gets anything. If it is a year when apples are scarce, he gets perhaps $1.50 to $2 per barrel for them; if apples are abundant, and consequently cheap, he gets from $1 per barrel down, his expense for barrels, freight and carting being the same in either case.

There is a market price for empty barrels at all times. In nearly every business packages and packing are charged to the person or company buying the goods; whenever goods are in bulk, — nursery stock, dry goods, furniture, etc., — a charge is made for cases. If producers of the latter classes of goods cannot afford to give away such material, it is certainly unjust to allow nothing to the farmer, whose profit is so much smaller. We have personally known of instances the past season where the farmer has received less than 50 cents a barrel net for his apples, and many who exported them received nothing; in the latter case the farmer made some one a present of at least $20 for every 100 barrels sent. These unjust practices should be corrected, and, if possible, the fruit industry of the State put on a business basis, so that young men may find it desirable to make fruit culture a profession, and older cultivators also be helped.

The total shipment of apples to foreign countries from all shipping ports in the United States in 1903 was 2,546,141 barrels; of these, 459,458 barrels were from Boston, 853,838 barrels were from New York. In 1904 the total shipment was 1,603,944 barrels; from Boston 439,675 barrels, and from New York 417,087 barrels. Shipments will continue during the winter.

Respectfully submitted,

WILLIAM H. SPOONER,
Chairman.

REPORT OF COMMITTEE ON FORESTRY, ROADS AND ROADSIDE IMPROVEMENTS.

[Read and accepted at the Annual Meeting, Jan. 10, 1905.]

The committee on forestry, roads and roadside improvements respectfully submits the following.

The State has progressed upon all these lines during the past year. Indeed, a State with the wealth of Massachusetts, her density of population and the independence of thought that exists within her borders, must inevitably advance in all useful, beautifying and æsthetic lines of progress.

The needs, and now the demands, of our business men for more intelligent forestry throughout New England have advanced in our State during the past year, by the enactment by the Legislature of 1904 of a law creating the office of State Forester. Mr. Alfred Akerman, a man trained on forestry lines, an expert, has been appointed to that office. His services are at the disposal of our citizens, under rules as to the payment of expenses, and so far as he finds that his time for such help can be so employed. He will also advise at our Agricultural College by lectures.

The term forestry must not be confused with that of ornamental and protective tree planting. There are, however, dangers that come to trees in general, under which all tree culture and tree care can be considered together.

In a previous report a suggestion was advanced of the possible value of collections of lantern slides, owned by this Board, for use under loan, and with lectures prepared by those who had given the subjects thus pictured especial thought and study. The suggestion was original, so far as this committee knew. During the past year the Office of Experiment Stations at Washington, under authorization, has adopted that plan, which is now available for a few lectures upon certain important subjects.

The improvement of our roads is becoming of greater value to the owners of farming and forest lands, as each new year opens, and consequently to the State at large. Highways are being promoted by this State, and the neighboring States lying to the north of us are striving to secure that legislative action which shall advance these interests, and apparently and naturally they desire to do so in a way that shall promote a New England system.

The whole nation is interested in properly advancing those natural conditions of each of her sections, so that, with our diversified climate, the several seasons of the year will find the greatest possible activity among the people promoted. Not only that, but, as Europe and other older lands have realized to the full extent the great value, in the promotion of general prosperity, of encouraging travel, they have recognized the underlying necessity of promoting in all ways those branches of agriculture that advance the beauty of the face of God's earth.

The accessibility of the mountain, sea shore, lake shore, etc., of the north, east, south and west of this nation, must be reasonably improved in order to promote this very important phase, which is a great factor, underlying the general prosperity of the nation as a whole. The move to give New England a national reservation is in our interest.

It is a benefit to Massachusetts to do all that she can, under reasonable financial conditions, to draw to herself and her more immediate neighborhood persons in active business and out of it, who are able to travel from foreign countries or from other parts of our own country.

It is well to provide for good roads and good roadsides, and it is encouraging to see evidences that the planting along our roadsides is becoming more recognized as a part of the scheme to protect the good roads which have been provided for us at much expense. Knowledge on all these lines has been greatly advanced by what the State has done.

It was my privilege to visit the New Jersey road expert, Mr. Owen, before our State began her highway work, and, in behalf of the Massachusetts Society for Promoting Agriculture, to invite him to deliver three lectures upon the value of better roads. I was with him at the rooms of the Massachusetts Horticultural Society in Boston, the rooms of the Worcester County Horticultural Society in Worcester, and at the rooms of the Essex Institute in Salem, for the three lectures. The Board can feel that the seeds then sown were in line with the work that it was desirous to promote.

Your committee has no special funds to work with, has a membership of five; but they believe that, in reality, the subject under which they have been called to act has now become recognized of so much importance to the people in general that the workers in behalf of better forestry, roads and roadside improvements are almost legion.

An appropriation of a few hundred dollars by the Legislature for sets of camera slides and prepared lectures might supplement the work being undertaken by our State Forester.

Approved by the committee,

FRANCIS H. APPLETON,
Chairman.

REPORT OF COMMITTEE ON INSTITUTES AND PUBLIC MEETINGS.

[Read and accepted at the Annual Meeting, Jan. 10, 1905.]

The summer meeting of the Board of Agriculture was held at Amherst, in order to look over more thoroughly than last year the farm, orchards, gardens and greenhouses; the meeting last year being so satisfactory that it created a desire to again visit the college grounds, to learn more about the better methods of preparing the soil for crops and feeding animals for milk.

The winter meeting of the Board was held at South Framingham, and was one of the most successful the Board has ever held. The speakers not only gave information of importance, but clothed it in language the most pleasing. A very large number of people were present at all of the sessions.

The institute meetings are doing a great work in the farming community. Every year progress is made in feeding crops and animals by methods given by the speakers at the institute meetings. Farmers have now much better opportunities for learning how to feed crops and animals than when the farmers' institutes were first organized; and, if present methods had been known then, it would have taken a much longer time for the farmers to learn them than it now does because of the institutes.

Respectfully submitted,

EDMUND HERSEY.
HENRY S. PERHAM.
ALBERT ELLSWORTH.

REPORT TO THE LEGISLATURE OF THE STATE BOARD OF AGRICULTURE, ACTING AS OVERSEERS OF THE MASSACHUSETTS AGRICULTURAL COLLEGE.

[Revised Laws, chapter 89, section 10, adopted by the Board, Jan. 10, 1905.]

To the State Board of Agriculture, Overseers of the Massachusetts Agricultural College.

The committee on Massachusetts Agricultural College, appointed by the State Board of Agriculture, submits the following report for the year 1904.

The Grinnell prizes were awarded as follows: first prize, to Arthur W. Gilbert of Brookfield; second prize, to Sidney B. Haskell of Southbridge. These prizes are awarded to the members of the graduating class who pass the best examinations in agriculture at the June commencement.

An interesting feature at commencement, June 15, was the memorial exercises upon the late Professor Stockbridge, who was particularly and peculiarly identified with the college history and work. A fine tribute to his service to the college, and his personal worth, was given by Mr. Wm. H. Bowker of the class of 1871, which tribute has been put in print.

The work of the college has been carried on upon nearly the usual lines. We have been pleased to note the increased patronage and the large number of the 1904 entering class. This has brought to our attention the fact that there is a pressing need, if not an absolute necessity, for larger and better equipments, in the way of buildings, class rooms, etc., in the horticultural, botanical and entomological departments. The summer meeting of the State Board upon the college grounds was of especial interest to the farmers of western

Massachusetts, as it gave them an opportunity to witness many of the object lessons of the college work, and experiments in spraying fruit trees and shrubbery, which in late years have become so much infested with insects and fungi.

The condition of the farm is excellent, and your committee was pleased to hear of proposed changes in the management and handling of the stock, with a view to making it more of a financial success in making use of the waste and by-products of the farm.

Your committee, while it notes an improved condition of the stock generally, of which considerable criticism has been made, would suggest that this branch of the work should be made an object lesson for all the farmers of the State; that the poorer animals should be disposed of and replaced with better ones, and the line of quality steadily raised, so that this may become the "Mecca" of stock men of Massachusetts, as it is for experimental work in other lines. The very best is none too good for the Massachusetts Agricultural College.

The work of this committee is largely a repetition of itself, and in a sense superficial. It inspects, it suggests, it criticises; it seems, in fact, the connecting link between the State Board of Agriculture and the college. It has grown into strong sympathy with the institution, and feels a deep interest in its success and growth. The institution needs some new buildings and some new farm machinery, to be properly equipped for the work that is manifestly before it. Massachusetts should meet these wants with a liberal hand. It is sowing seed for a future harvest that cannot be measured in dollars and cents.

The depleted condition of soil from long use, the incoming of pests, scales and fungous growth, demand a different style of farming from that our fathers followed when conditions were different. Hold an institute in any farming town in Massachusetts, and call in a scientific agriculturist to make the formal address, to be followed by a discussion of the subject, and you will see, in the questions asked, the respondent influence and enlightenment of this college. So we think it is for the advantage of the State Board of Agriculture, as well as the general public, to come closer to this institution. All these interests are collateral, and need each other's support. New times demand new measures, and ofttimes new men.

The moving finger writes,
And, having writ, moves on.

Respectfully submitted,

JOHN BURSLEY.
C. K. BREWSTER.
A. A. SMITH.
C. H. SHAYLOR.
W. C. JEWETT.

REPORT OF COMMITTEE ON GYPSY MOTH, INSECTS AND BIRDS.*

[Read and adopted at the Public Winter Meeting, Dec. 6, 1904.]

To the Massachusetts State Board of Agriculture.

Your committee on the gypsy moth, insects and birds presents herewith its report for the year 1904. As in recent years, the work of this committee has been restricted, through lack of funds, to observing and recording the increase of the moth, informing local authorities of the appearance of new colonies, and advising citizens concerning the best means for combating outbreaks of the gypsy and brown-tail moths. Owing to the great increase in these pests, this latter feature of our work, conducted largely through the office of the secretary of the Board of Agriculture, has grown to considerable dimensions. Several hundred letters of advice have been written in answer to inquiries, while many more applications have received personal attention at the office. While the calls for assistance were most numerous during the early summer months, when the caterpillar outbreak was in full force, there has been a steady and constant demand throughout the year for advice concerning the best means for destroying the insects.

In response to the general demand for detailed information as to remedies for these two pests, the secretary of the Board issued a special article on the "Gypsy and brown-tail moths," in the Massachusetts Crop Report of July, 1904. This article, widely reviewed by the press of the State and illustrated by excellent cuts of the insect, gives a full statement of their habits, and describes the preparation and use of effective remedies. It may be had upon application to the secretary of the Board.

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* House Document, No. 3, 1905.

As is well known, active work against the gypsy moth was discontinued by action of the Legislature Feb. 1, 1900, the field work practically ending at the close of the calendar year 1899. The insect has thus had five years in which to increase unrestricted, except for such efforts as have been put forth from time to time by individuals and municipalities.

The claim advanced by many, at the time the State work stopped, that every property owner would fight the pest on his own property, has thus been put to trial. It is profitable, as showing the efficacy of individual effort against the insect, to review briefly the conditions existing in 1899 at the close of the State's systematic attempt to suppress the moth, and contrast them with those obtaining at the end of five years of effort on the part of individual property owners, and in some cases by municipalities.

Condition of Infested Region. — 1899 *v.* 1904.

Within the two years ending December, 1899, practically the entire infested territory had been thoroughly examined by trained employees, a large part of the examination having been made in the year 1899. The report of the committee for that year, together with the additional report of the special legislative investigating committee, gives statements concerning the actual condition of the moth-infested district at that time. As a basis for comparison of present *v.* past conditions, we have the results of the very thorough examination of the region made the past summer by Prof. C. L. Marlatt, first assistant entomologist, United States Department of Agriculture, and Mr. A. H. Kirkland, a local entomologist who is thoroughly familiar with the insect and the territory it occupies. Professor Marlatt has kindly sent us an advance copy of his report, while Mr. Kirkland has placed his copious notes at our disposal. From these several sources there are thus available reliable data concerning the condition of the several infested cities and towns in 1899 and in 1904.

For convenience, we have adopted the classification of "central" and "outer" cities and towns, as used in past reports. The "central" towns are those lying nearest the centre of infestation, and naturally are those where the moth's depredations have been longest known and most severely felt; the "outer" towns are those lying outside the central towns, and, being infested to a less degree, have suffered less damage from the pest, although containing at one time or another colonies of importance.

CENTRAL TOWNS.

Everett.

1899. — There were a few small infested areas in the city of Everett in 1899. The moth was known to occur on a few estates near Central Square, on Ferry Street near the Chelsea line, on property near the Malden line, while a few caterpillars were found in the Woodlawn Cemetery. In none of these places, however, had there been any stripping of trees or notable injury by the moth. The infested areas were well known, but as a result of very thorough work had been brought under control. A few years' more work would have doubtless resulted in their extermination.

1904. — At this time the moth has increased from the few scattered infestations existing in 1899 to a point where the northern part of the city is generally infested, and throughout this section the past season a considerable amount of stripping of trees occurred. The southern part of the city is not as badly infested, although scattered colonies occur throughout the entire city. Everett has suffered not only from the natural increase of the moth within its own borders, but by the unfortunate transportation of the insect from the large neglected colonies in Malden. The general occurrence of the egg clusters throughout the city is a matter of common knowledge, and as a whole it is seriously infested by the moth. A few years more of neglect will witness a large amount of damage by the pest in this locality.

Malden.

1899. — Malden, being one of the cities longest infested, and often neglected because of the pressing need of work in the outer cities and towns, was quite generally infested by the gypsy moth at the close of the State's work in 1899. While there had not been more than three or four acres all told stripped by the moth during the season of 1899, scattered colonies of considerable size were known to exist in the eastern and northern parts of the city. The residential portion was quite free from the pest.

1904. — The city of Malden is now solidly infested by the gypsy moth. It is, in fact, difficult to find a tree on any of the principal streets which does not bear one or more egg clusters, while on some of the trees they may be counted by the thousand. In the Edgeworth section hundreds of trees were completely defoliated during the past season, while in the northern and eastern part of the city the stripped trees presented a shocking sight at mid-summer. In this city alone at least two hundred acres of woodland and residential districts were completely defoliated. Property owners report sweeping from one to twelve quarts of the caterpillars from house walls every morning during the feeding season. One resident on Glenwood Street, who kept a fairly accurate account of the caterpillars so obtained, reported that he had captured and destroyed in this way over a barrel of these insects during the summer. Words can hardly describe the terrible condition existing in northern and eastern Malden at the height of the caterpillar outbreak. From the Medford line to the Saugus line the woodland was practically defoliated.

Medford.

1899. — Residential portions of the city were generally infested, although no serious damage by the moth took place in that section. In 1899 the large woodland colonies were well known and circumscribed in area, and by means of rigorous measures had been brought under control. At the time the work stopped there was a considerable number of gypsy moth nests occurring throughout these woodland colonies in the northern part of the city, but in the year mentioned not over two acres had been defoliated by the moth.

1904. — What has been said above of the Malden conditions for this year holds true of Medford, except that the devastation and annoyance by the insects described must necessarily be amplified to meet the worse condition in Medford. The city is solidly infested from one end to another. In the southern residential portion shade trees on hundreds of private estates were stripped, while the trees in the residential section at West Medford appeared as if swept by fire. Only the most patient, thorough and continuous work on the part of property owners in that section prevented all the trees in that district from being defoliated. Thousands of quarts of caterpillars were gathered by hand and destroyed. Spraying was freely resorted to, and the morning inspection of the trees became a household duty, which took precedence over all other matters. The remains of the old woodland colonies in the northern part of the town previously referred to have now increased to such an extent that about three hundred acres all told were practically defoliated the past year. The beautiful Pine Banks region in the Metropolitan Park was completely devastated, and hundreds of young pines killed outright, in spite of the earnest and faithful endeavors of the employees of the Park Commission. Gen. S. C. Lawrence, one of the largest property owners in the city, found it again necessary, as in recent years, to employ a large force of men in combating the moth on his woodlands. Many thousands of dollars were so spent by this public-spirited citizen, but with only a partial measure of success, owing to surrounding infestations on neglected woodlands. The numbers of egg clusters now existing in Medford are truly formidable, and constitute a serious omen for the season of 1905.

Melrose.

1899. — The moth colonies in Melrose at the close of 1899 were few in number and widely separated. Near the Malden line in the woodlands a few colonies of importance had developed, but not over an acre of woodland had been defoliated. The residential section was practically free from the insect. In fact, throughout the town the average observer might travel for days without finding a single specimen of the moth in any stage.

1904. — Melrose to-day is nearly as badly infested as Malden. The woodland near the Malden and Saugus lines in the southern and eastern parts of the city was practically defoliated, and the residential district in that section suffered severely from the moth. At Melrose Highlands a large colony, occupying perhaps fifty acres, has appeared. Another occurs in the western part of the town, near the Stoneham line, and over this area nearly all the trees were stripped. At the time the work stopped, in 1899, Melrose was in a condition where two years' work on the part of a small force could have exterminated the insect from the city. To-day an outlay of many thousands of dollars would be necessary merely to suppress the pest, without reference to its extermination.

Saugus.

1899. — The residential district of Saugus occupies but a relatively small area, as compared to the woodland districts in the northern and western parts of the town. Throughout this woodland area moth colonies were known to exist as early as 1894. A scouting of Saugus made in the late 90's revealed a considerable number of large woodland colonies. This woodland being of scrub growth and of little value to the owners, it was possible to employ here the more heroic methods of cutting and burning on a large scale. At the close of 1899 many of the colonies were considered to be free from the moth, while in others but few egg clusters could be found.

1904. — While the moth has not again appeared in several of the old colonies which were wiped out previous to 1899, in a number of the woodland colonies the insects have multiplied to as great an extent as at Medford or Malden. Blocks of woodland, containing in some cases fifty acres or more, were completely stripped. The woodland along the electric road leading from Saugus to Wakefield was defoliated, while in the western part of the town, near the Melrose and Malden lines, large areas of woodland were stripped by the caterpillars. From these woodland colonies the residential sections have now become badly infested, and much harm and annoyance was wrought there by the caterpillars in the past season.

Winchester.

1899. — Previous to 1899 there had existed in this town a number of important woodland colonies, which had received the careful attention of the employees of the Board, with the result that many of them were practically suppressed. A small colony in the southern part of the town showed about one-half an acre stripped by the moth, this being one of the most important infestations of the year. By vigorous use of the burlap the residential section had been rendered nearly free from the moth.

1904. — Several of the woodland colonies in the western part of the town are now grown to formidable size, and many acres were defoliated the past year. The woodland colony in the southern part of the town, previously referred to, has increased many fold, and now extends over fifty acres, more or less. Winchester has been fortunate in having a most active and progressive tree warden, thoroughly familiar with the work against the gypsy moth and the danger from its presence. As a result of his work, supported by a most commendable spirit on the part of the tax payers, the residential section of the town has been kept practically free from the insect. The increase in the woodland colonies, however, makes the problem of keeping the residential section free from the insects more and more difficult each year.

OUTER TOWNS.

Arlington.

1899. — Although Arlington is near the centre of the infested district, yet, from its excellent condition as regards moth infestation, it was considered as one of the outer towns. In 1899 the residential section was practically free from the moth. The woodland colonies in the northern part of the town were well under control, and in great measure suppressed. An untrained observer would have had difficulty in finding a single gypsy moth in the town.

1904. — The close of this year finds Arlington about as badly infested as any of the cities or towns. From the Belmont line to the Mystic Lakes a large part of both woodland and residential district was completely defoliated. The beautiful estates along the west bank of the lakes suffered severely, and here many valuable pines and spruces were killed by the caterpillars. In this town, as at Belmont, Malden, Medford and elsewhere, public-spirited citizens have struggled bravely to keep their own places free from the moth; but, from the general occurrence of the pest and the numerous neglected estates, the fight has been an unequal one. To suppress the moth in this town, a large amount of work and a consequent outlay of money must be made. It is important that the moth should be suppressed here, because of the many avenues of traffic leading through the town, by means of which the caterpillars will otherwise become spread over a large area.

Belmont.

1899. — At the close of the State work Belmont had been quite thoroughly examined. A few small colonies were located in the northern part of the town, and others of minor importance discovered in a few localities elsewhere. The eastern and northern sections of the town were scatteringly infested, the most important colony being in the woodland, near the Arlington line. Here a great deal of thorough work was done by the employees of the committee, and the colony put in excellent condition for exterminative work.

1904. — Through the neglect of the remnants of the woodland colonies previously mentioned, the insect slowly increased there from year to year, until the past summer it swept like a devouring swarm over perhaps one hundred acres of woodland, and ruined shade trees and shrubbery on many beautiful private estates. As yet the residential portion of the town is only scatteringly infested, but with the large woodland colony remaining on the north and with the other infestations of the town it is but a question of time, unless active measures are taken, when the whole town will become thoroughly infested.

Boston.

1899. — At the close of the year 1899 a small infestation was known to exist at Orient Heights, and another one at Cottage Street in the Dorchester district. These were thoroughly dealt with at the time of their discovery. The Cottage Street colony has since received the attention of Mr. William Doogue, city forester, and has been practically wiped out.

1904. — The Orient Heights colony has now developed to a point where considerable stripping of trees was noticed last summer. A colony of considerable importance has been found on Commonwealth Avenue, and another at Allston. There can be little doubt that the moth has spread into the city at many points from the badly infested sections lying to the north and west, and that many incipient colonies now exist within the limits of Boston proper.

Brookline.

1899. — The town of Brookline was practically free from the moth at the close of 1899. In this town a great deal of very thorough and careful work was done by the employees of the committee, with the result that at the close of the work it was believed that the moth had been practically exterminated from the town.

1904. — It is now evident that the moth was exterminated in the old Brookline colonies, since careful examination at the end of five years fails to show any presence of the insect. There are, however, a few small colonies now in existence in Brookline, the insects probably having been brought in within recent years from other infested localities.

Burlington.

1899. — Two small colonies of the moth were known to exist in woodlands. These were treated by cutting out and burning the underbrush, destroying the eggs, and putting the colonies in condition for burlapping the following season.

1904. — The woodland colonies mentioned above have now developed to small proportions, a few hundred egg clusters being found in each. As yet the insects have done no particular harm here, but will make their depredations felt in a year or two, if neglected.

Cambridge.

1899. — At the close of 1899 there were several small infestations in this city, but none of any special importance. Here and there in the residential sections small colonies occurred, but none which offered any serious obstacles to remedial treatment as soon as the larger colonies in the outlying towns could be suppressed. From the immense traffic through this city, caterpillars were continually brought in from infested localities lying to the north, and thus kept up a small although constant infestation.

1904. — The residential part of Cambridge is now quite generally infested by the gypsy moth. The insects have already reached a point where considerable damage to trees has taken place, much stripping being noticed this year in the Brattle Street district, also near the Harvard Botanic Gardens, and to a less extent at North Cambridge. The moth has made a rapid increase in this city, although much has been done to suppress it by the park superintendent and by individuals.

Chelsea.

1899. — A few egg clusters and caterpillars were found in Chelsea in 1899. These probably resulted from straggling insects brought in from Malden and Everett. The city as a whole was in very good condition.

1904. — Several sections of the city are now quite thoroughly infested. The moths are most noticeable along the main avenues, near the Everett and Revere lines. The city does not offer any particularly serious problems in the way of control measures, if the moth could be suppressed in the larger infested localities to the north.

Georgetown.

1899. — The Georgetown colony offered a unique problem. It involved several acres of woodland, which were completely stripped in the season of 1899. The land not being particularly valuable, it was possible to cut out and burn the entire colony, and to carry this heroic treatment over a considerable area lying outside of the known infested section. The fall examination showed only nine egg clusters, which were destroyed.

1904. — With five years in which the insect could multiply, a very careful examination of this colony failed to reveal a single specimen of the gypsy moth. While it is still possible that colonies may develop elsewhere in the town, from insects scattered from the original colony by teams or birds, it is apparent that the old centre of infestation, which offered one of the most formidable problems the committee was ever called upon to face, has been completely wiped out.

Lexington.

1899. — At the close of the year the woodland colonies offered the most serious problems in this town. The town had been thoroughly examined, and its exact condition determined. In the southern part, near the Arlington line, several small colonies were located, thoroughly treated, and put in condition for exterminative work. The old colonies in the south-eastern part of the town were in excellent condition.

1904. — The remnants of the old colonies in the woodlands have now increased to such a point that considerable stripping of trees occurred the past summer. An important colony has also developed near the Woburn line, and here woodland and shade trees have been seriously injured. The tree warden of this town has done excellent work in suppressing the moth, so far as his means would permit; but the insect has made a steady gain, and at this writing not only a large part of the woodland but also a considerable part of the residential district is badly infested.

Lynn.

1899. — There were practically no important moth colonies in Lynn at the close of the State work. Scattering infestations of small size occurred in the woodland, but were very thoroughly treated during the summer of 1899. A few localities were infested in the residential district, and these also were thoroughly treated.

1904. — The good work done in Lynn previous to 1899 has been verified by the results developing in that city to date. While the small infestations have now grown to moderate size, the city as a whole is still in very good condition, if we except the part nearest the Saugus line. In that section there has been a very undesirable increase in the numbers of the moth. In the northern part of the town the Lynnfield colony has extended southward into the wooded area, while near Walden Pond there is another woodland colony of considerable size.

Lynnfield.

1899. — At the close of the year the town was practically free of the moth. A small number of insects had been taken in the southern part of the town, but aside from that there were no colonies of importance.

1904. — A large woodland colony, involving perhaps one hundred acres, has now developed in the southern part of the town, and stretches southward over the border of Lynn. This colony has made a very rapid development, and, from its occurrence near the northern border of the infested district, is one of the most important in the whole list. Another colony has developed at North Lynnfield, but this has received an important check through the lumbering operations which have been carried on there.

Manchester.

1899. — Only sixteen egg clusters were found in the entire town of Manchester this year. A single season of very thorough work had practically suppressed the large colonies found there in 1898. In no place was more thorough work done by the employees of the Board, and the results at the close of 1899 proved the wisdom of applying such measures.

1904. — But a few specimens of the moth were found in this town the present year. The old colonies seem to be apparently wiped out, and it is highly probable that the insects found in the town this year were brought in from outside sources.

Marblehead.

1899. — Slight infestations were found in the town at the close of 1899, but none of any formidable size. These colonies were thoroughly treated, and the town left in good condition for exterminative work.

1904. — A colony of considerable size has developed near the Swampscott line, while in the residential section there are two or three infestations of minor importance. These infestations are only the natural result of allowing the remnants of the old colonies to multiply unrestricted. The conditions at present existing in this town, however, do not offer any formidable difficulties in the way of suppressing the moth.

Nahant.

This town, once cleared from the moth, had become slightly infested in the fall of 1899. The colonies then in existence were promptly stamped out. It is now generally infested.

Newton.

1899. — A colony occupying a large area in the Oak Hill district at Newton was located in the summer of 1899, cut out, burned over and given very thorough treatment. The colony was not of special importance from the severity of the moth attack, but rather from its location, and from the fact that it was scattered over a large area.

1904. — In the time which has elapsed since the close of the State work the infested localities of Newton have had very thorough treatment at the hands of Mr. C. W. Ross, superintendent of streets of that city. The result is that, while the moth still occurs in the city, and while there are now three or four important colonies, somewhat widely separated, the situation is well in hand, and does not offer any especially difficult problems if thorough work can be continued.

Peabody.

1899. — The fall examination of this town in 1899 resulted in the finding of only four infested localities, and these contained all told but sixteen egg clusters. The town was in excellent condition, and nearly free from the moth.

1904. — The central part of the town is now badly infested, and the same holds good with the section known as South Peabody. Along the Andover road as far as the Danvers line there are numerous important colonies, and here several orchards were stripped the past year.

Reading.

1899. — At the close of the year an inspection of the entire town showed a few colonies, which were thoroughly treated as soon as found. The town as a whole was in excellent condition.

1904. — While several of the old colonies are apparently exterminated, there has been a large increase in the infestation of the residential sections. Along the car lines and main roads leading to Reading Square the moth is now quite generally distributed, and the need for thorough work against the insect throughout this section is obvious, if the pest is to be suppressed.

Revere.

1899. — Quite a number of scattering colonies in this town received attention during 1899. Here and there throughout the town were the remains of old colonies, but none of any serious magnitude.

1904. — Serious damage was caused by the moth in the Franklin Park section, where all the woodland was practically defoliated by the caterpillars. The same statement applied to the trees along Malden Street, where the damage was nearly as great. In the residential section and in the district toward Beachmont several small colonies have developed. The town is now quite generally infested, and a great deal of thorough work must be done here to hold the moth in check.

Salem.

1899. — At the close of the year a thorough examination of the city showed it to be in excellent condition. Only six caterpillars were taken in the residential part of the city. The old colonies were practically wiped out, and the attention of a small force of men for a year or two was all that was needed to free the city from the moth.

1904. — To-day the residential part of the city is quite solidly infested, particularly along the streets running toward Peabody. Serious colonies occur along Highland Avenue and in the section known as the Great Pastures. The moth is increasing rapidly in this city.

Somerville.

1899. — In the year 1899 only a few scattered caterpillars were found in this city, and these no doubt were brought in from the infested sections of the north. The city as a whole was in excellent condition.

1904. — The city authorities have shown great energy and skill in following up infestations of the gypsy moth, and are largely responsible for the present good condition of the city. There are, however, quite a number of infested localities, particularly along the main avenues of travel. These moth colonies are increasing from year to year, and it is apparent that so long as the large infested sections remain to the north of Somerville, the numbers of the moth here are bound to increase.

Stoneham.

1899. — The residential section of Stoneham was practically free from the moth at the close of the year. In the southern part of the town there were a number of woodland colonies under control, but where the moth still occurred in important numbers.

1904. — The residential section of the town is now thoroughly infested, some stripping of shade trees has already occurred, while the woodland colonies in the southern part of the town have developed to formidable numbers. In those colonies occurring in the metropolitan park system a great deal of very effective work has been done by the Park Commission employees, under the direction of Mr. Charles Price, superintendent. The condition of the town as a whole, however, is distinctly worse than in 1899.

Swampscott.

1899. — A few eggs were found in the fall inspection of Swampscott in 1899, but aside from that the town was apparently free from the moth.

1904. — A hasty inspection of the town shows that the moth has not developed to any extent within its borders. There are a few small colonies in the residential section, and an infestation near the Marblehead line, aside from which the town still remains in good condition.

Wakefield.

1899. — At the close of the State work there were a few woodland colonies in the eastern part of the town, while scattered infestations occurred throughout the residential district. A great deal of very thorough work was done in this town during the year, and as a result it was left in good condition at the close of the work.

1904. — A number of important moth colonies have developed in the southern part of the town, while along the main road leading to Saugus serious depredations have been caused by the moth. A large number of shade trees have been defoliated, while woodland colonies of importance have also developed. The town is not in as bad condition as Melrose or Saugus, but still contains a number of very seriously infested localities.

Waltham.

1899. — The old woodland colony at Waltham was practically stamped out in 1899, but eight caterpillars being taken there that year.

1904. — A quite thorough inspection of the main roads of Waltham this year, and also of the old colony previously referred to, gave very satisfactory results. A few egg clusters were found in the central part of the city, but none in the old colony mentioned. It seems apparent that the city is in very good condition as regards the moth.

Watertown.

1899. — The only caterpillars taken in Watertown in 1899 were found in the Mt. Auburn Cemetery. The town was in excellent condition, and practically free from the moth.

1904. — To-day the town of Watertown is seriously infested, from the centre to the Cambridge line, while in the western district near the Waltham line there is a large colony which extends northward to Belmont. Along Mt. Auburn Street a large number of trees and several orchards were completely stripped. The severe infestations at Watertown, supplying, as they do, thousands of caterpillars, are a serious menace to property in the vicinity of Harvard Square, Cambridge, and probably account for the rapid increase of the insect along Brattle Street in the latter city.

Winthrop.

1899. — But a single egg cluster of the moth was found in Winthrop in the fall of 1899. The town was practically clear of the moth.

1904. — In the Beachmont section there is now an important colony, while along the line of the Boston, Revere Beach & Lynn Railroad there are a number of badly infested localities. These places do not offer any serious obstacles for treatment, but must of necessity grow worse if neglected.

Woburn.

1899. — This city was infested in a number of localities at the close of 1899, but was in such excellent condition that no stripping of trees had occurred. The woodland colonies were practically cleared out, and in many of them no form of the moth had been found during the year.

1904. — The residential portion of the city is now thoroughly infested. There is a large colony near Beach Street, while important colonies also occur in the eastern part of the city and also near the Lexington line. The moth is rapidly increasing in Woburn, and the problem here should receive prompt attention, if damage by and further spread of the insect are to be prevented.

NEW COLONIES.

Since the close of the work against the gypsy moth a few new colonies have developed in districts outside the infested area known at the close of 1899. In nearly all these cases agents of the Board have investigated and verified the finding of the moth. At East Bridgewater, Mass., a small colony involving a few old apple trees was found in 1903, and thoroughly treated by the owner under the advice and direction of the local tree warden. No living specimens of the moth were found there at the time of the fall examination the present year. Specimens of gypsy moth caterpillars said to be found in Scituate, Mass., were brought to the office of the Board of Agriculture during the past summer, but this finding has not been verified by examination of the alleged infested district. At South Framingham, Mass., a few specimens of the gypsy moth had been found, as verified by Mr. N. I. Bowditch of this committee. At Billerica, Mass., a small colony has developed near the centre of the town; while Gloucester, Mass., has also become slightly infested, doubtless through insects brought in on vehicles. North Andover is also infested.

PRESENT DANGER FROM THE MOTH.

The committee has not thought it necessary in this report to go into the matter of the damage and injury caused by the gypsy moth, since these facts are matters of common knowledge. The annoyance caused by the caterpillars, the injury to crops, trees and shrubbery, the devastation of woodlands occurring during recent years, are only too familiar to the residents of the infested districts. There are two points, however, on which the committee wishes to place particular emphasis. We refer to the killing of trees by the moth, and the danger of spreading into non-infested territory.

It has been held by many well-informed parties that stripping by caterpillars, while it might check the growth of trees, would not result in their death. We have therefore watched with particular interest certain areas in Malden and southern Melrose, where the insects have been allowed to devastate woodlands annually for the last three years. Our examinations show that in these sections hundreds of large white pines had been killed in every case as the result of a single stripping by the insects. The deciduous trees have suffered to a less extent, but three defoliations and in some cases two have sufficed to destroy large oaks and apple trees. With this evidence at hand there can be no question that the gypsy moth, left to itself, will kill trees. This fact is of importance in its bearing toward both forest and orchard interests.

However serious devastations of the moth have been throughout the northern metropolitan district, and however much annoyance, damage and financial loss it has caused property owners, in our judgment, this phase of the matter is not of as serious moment to the citizens of the State as the wholesale distribution of caterpillars which takes place from every large colony. As has been well established, the insects spread chiefly in the caterpillar stage, when they drop on passing vehicles and are carried from place to place. As soon as a moth colony near any of the main roads reaches the swarming stage, distribution from that point is bound to occur. It is indeed a serious question if the neglect of the large moth colonies and the consequent swarming of the caterpillars in them during the past few years has not resulted in a notable dispersion of the insects throughout a large area of territory heretofore free from the moth. There can be no more successful way to bring about the dissemination of the gypsy moth throughout the entire State than to continue the policy of non-action which has prevailed in recent years.

THE PARASITE QUESTION.

It has been hoped by many that if the gypsy moth was allowed to increase, its natural enemies, of which a large number occur in this State, would also multiply to a point sufficient to check or control the pest. This question has received careful attention, and it is apparent that at the end of five years the gypsy moth has multiplied at a much greater rate than its natural enemies, increased in severity of damage to property and spread outward over an enlarged area. From this condition of affairs it is evident that but little help may be expected from our native parasites, and that whatever is to be done for the immediate relief of our citizens must be accomplished by human efforts.

Your committee has borne in mind the fact that the gypsy moth, while a serious pest in Europe, has there its years of activity, alternating with those of non-action. This condition of affairs indicates that in Europe the combined action of its numerous natural enemies under the climatic conditions prevailing there is sufficient to check the increase of the moth. While it is known that there is no single parasite notably effective in controlling the moth in Europe, we have thought it possible that there might be several parasites whose combined effort might be sufficient to check its increase. Without going into details, it is well to state that the law under which your committee operated up to the close of the work made it impossible to send experts abroad to investigate this matter, or to leave untouched the large colonies in this State which would be necessary for the successful introduction and breeding of parasites. Now that the State has abandoned the idea of exterminating the moth, and the question has become simply one of controlling its increase and spread, we think it highly desirable that an investigation of the gypsy moth in Europe should be made, particularly with reference to discovering such parasites or contagious diseases as may be effective in checking the increase of the insect. A work of this kind calls for the highest technical skill, and we are glad to learn that the chief of the Bureau of Entomology of the United States Department of Agriculture, Dr. L. O. Howard, is taking steps to investigate this important subject. Dr. Howard's reputation as a scientist is a sufficient guarantee that any work done under his direction will be carried out in the most thorough manner, and this committee stands ready to co-operate with him to the fullest possible extent. Lacking State appropriations for this purpose, it seems highly desirable that national aid should be obtained for this specific work, and your committee is already acting along these lines.

SUMMARY.

The condition of the moth-infested region at the close of 1899 may be well summarized in the words of this committee's report for that year: "The entire infested district was never so free from the gypsy moth since the beginning of the State work as at present." The large woodland colonies were completely under control, many of them had been exterminated. The residential districts had been practically cleared of the moth. Ten acres all told would be an ample estimate of the entire stripped area in all the cities and towns for 1899. In the words of the special investigating committee (March, 1900), "The infested spots are scattered. There are to-day, so far as known, no large colonies;" and again, "There are to-day no known colonies in existence."

Against these facts, whose accuracy has never been called in question, must be placed the conditions as they exist to-day. Instead of minor damage here and there in residential districts, we have reports of the destruction of shade trees, orchards, gardens and shrubbery over a large part of the entire infested area. Not only are growing crops and trees devastated, but houses are invaded and sidewalks swarmed with the disgusting insects. Tenants have often forsaken their homes because of the plague, and in the worst infested sections real estate values have been notably depreciated.

The weak woodland colonies once thoroughly under control have increased by leaps and bounds, leaving large forested sections as bare at mid-summer as in winter, and breeding enormous numbers of insects to infest still larger areas. From the Belmont line to the Saugus River, a distance of ten miles, there was last summer an almost continuous succession of colonies.

Professor Marlatt, after seeing the shocking condition prevailing in the infested district in July, writes: "The conditions found in 1902 scarcely prepared the writer for the status shown in the course of the investigations just completed. During the years 1903–1904 the gypsy moth had evidently made extraordinary progress, and defoliation or stripping was found which the writer had never seen before in the gypsy moth region, and undoubtedly many times greater than in the worst of the earlier years of gypsy moth damage."

In the foregoing pages we have endeavored to present fairly the present conditions of the moth-infested regions. While property owners have suffered severely, and call in no uncertain tones for relief from the scourge which they are unable to combat successfully, we face also a serious menace to our agricultural interests, which would follow the unrestricted spread of the moth throughout the State.

In view of the alarming condition above reported, the imminent danger of the further spread of the moth, the great damage now being wrought to shade, fruit and forest trees in the infested territory, and the large sums expended by municipalities and individuals in fighting the pest, with the certainty of immense increase of damage and expense with the further spread of the insect, your committee believes that the time has come when some concerted and vigorous action should be taken, looking to the control of the pest.

The question of extermination has been solved through the suspension of the work and the unchecked increase and spread of the insect. We believe that extermination was possible at the time the work ceased, granted that appropriations were made seasonably and in sufficient amount to do the work planned for, over a period of years when the infestation had become so scattered and inconsiderable as to be of no immediate damage to vegetation. The best that can be hoped for now is control, the reducing of the insect to a condition where no visible harm results from it, and the holding of it within its present limits, with perhaps the occasional extermination of isolated colonies in the outlying towns. The expense of this work will be considerable at first, — greater, if properly done, than the expense of the exterminative work formerly carried on, but gradually decreasing in amount until a moderate yearly appropriation will suffice. In other words, the gypsy moth has become a perpetual tax upon the Commonwealth or the nation, and the tax will be paid, whether appropriation is made or not.

There is no question but that this insect should be dealt with by the national government. By its unchecked spread during the last five years it has reached a point where it is not only a damage to Massachusetts, but also a distinct menace to neighboring States. With the millions of caterpillars to be found about railroad stations in the infested district during the summer months, it is only a question of time when some of them will find lodgment, in sufficient numbers to reproduce their kind, on freight or passenger cars, and be carried hundreds or perhaps thousands of miles, perhaps into the White Mountains, perhaps to Texas or Oregon, there to lay eggs and start a new centre of infestation. Precedent for government action is established by the appropriation made for fighting the cotton boll weevil, which attacks but a single plant, though a most important one, while the gypsy moth feeds on practically all kinds of vegetation. Your secretary has already communicated with the agricultural departments of other New England States and New York, and all have expressed themselves as ready to join with Massachusetts in urging the necessity for appropriation upon Congress. We would recommend that the State Board of Agriculture urge upon our Senators and Representatives in Congress the necessity for this appropriation, and the importance of earnest work to secure it. We would further recommend that the General Court memorialize Congress in aid of an appropriation for this work.

Massachusetts cannot expect, however, that the national government will come to her aid until she has shown a disposition to take up the fight and at least keep the insect in subjection. For that purpose we recommend that a large appropriation be made, extending over a number of years, so that the work may not be stopped at any time for lack of funds, with a maximum and minimum amount to be expended in any one year, work to be done against the insect at all seasons and in all forms. At present, as Professor Marlatt has pointed out in his report on the condition of the gypsy moth territory, almost if not quite as much money is being expended yearly by municipalities and individuals as was expended in the years when the State made its largest appropriations. We may well ask, to what end? Excellent as much of this work is, strive as public-spirited citizens and progressive municipalities may to rid themselves of the moth, what is the result? Simply reinfestation from surrounding estates or towns, and the whole weary work to be gone over again, at perhaps added expense. Your committee believes that nothing of permanent value will be accomplished until the work is again in the hands of some central authority, either State or national, or both in co-operation.

In the opinion of this committee, the time has come when this work should be placed in the hands of a paid commission, the members of which can devote their entire time to the work. This work was placed upon the Board of Agriculture in 1891 without its solicitation, — indeed, against its protest; was carried on by it to the best of its ability, and relinquished on the failure of the General Court to make appropriations, with forebodings as to the ultimate result to the fruit, forest and shade trees of the Commonwealth, but not without a sense of relief at the cessation of a thankless and unpleasant task. During the continuance of the work the members of the committee having it in charge gave it from twenty to fifty days each of their time each year, without compensation other than their travelling and necessary expenses. We submit that this is too much for the Commonwealth to expect of its unpaid servants, and the problem is now a greater one than before the lapse of the work. The method of appointment and term of service of such a commission, together with the compensation of its members, must be left to legislation; but your committee is convinced of the entire necessity of this action in some form.

We would earnestly advise that the municipalities and citizens now endeavoring to check the progress of the moth continue in their work. Their efforts will be an aid in case of future appropriations, and in failure of such action will in some degree mitigate the severity of the pest during the coming summer.

Respectfully submitted,

AUGUSTUS PRATT.
JOHN M. DANFORTH.
W. C. JEWETT.
HENRY H. LEACH.
WALTER D. ROSS.
J. LEWIS ELLSWORTH.

THIRD ANNUAL REPORT

OF THE

STATE NURSERY INSPECTOR

OF THE

MASSACHUSETTS BOARD OF AGRICULTURE.

PRESENTED TO THE BOARD AND ACCEPTED,
JAN. 10, 1905.

THIRD ANNUAL REPORT OF THE STATE NURSERY INSPECTOR.

To the Secretary of the Board of Agriculture.

I have the honor to submit herewith the third annual report of the State Nursery Inspector.

During the year 1904 the duties of the State Nursery Inspector have been the same as in previous years, and the work has been of the same nature. Five places inspected last year are now out of business, but twelve others have been added to the list, making a total of one hundred and seventeen nurseries in all. These are scattered from Amesbury to Nantucket, and from Cohasset to Lee, causing a great deal of travelling in order to reach them all. In most cases, too, land whereon nursery stock can be grown is too valuable for this purpose within city or village limits, necessitating the covering of considerable distances either on foot, by trolley or by wheel, after the post-office address of the nurseryman has been reached. The distance walked in this way by the inspectors certainly exceeds one hundred miles, nearly all of it in pieces of not more than a mile or two, — not enough to make carriage hire worth the while.

Regular inspections began this year August 15, and the last certificate was given October 8, though all but a few re-inspections had been completed by September 16. That so many places could be inspected in this time was due to the unusual conditions existing during this period, only one day being lost by bad weather. This was also a large factor in the expense of the work, as no living expenses were incurred without any inspections having been made. To this may be attributed the surplus shown in the financial statement, whereas, if the inspectors had been on the road during much stormy weather, their necessary expenses would have easily turned the surplus into a deficit.

It should not be forgotten in this connection that when the inspection law was drawn and the appropriation therefor fixed, only thirty-two nurseries were known, and even then it was suggested during the preparation of the bill that the appropriation should be made two thousand dollars; to-day one thousand dollars covers the cost of inspecting nearly four times as many nurseries as it was at first feared that this sum would be insufficient for. The appropriation as it stands is none too large, however, and any year it may prove too small, either because of bad weather during the inspection season, or by an even small increase in the number of places it is necessary to inspect.

The injurious insects and diseases guarded against by inspection in Massachusetts are less numerous than in some of the central and southern States, but are still important enough to require the most careful work on the part of the inspectors. It is perhaps well here to consider these pests in some detail, and particularly with reference to their distribution and abundance in the nurseries of the State.

Of the plant diseases, crown gall has not thus far been discovered by inspectors in Massachusetts. Farther south it is very serious, and is the cause of much loss. Whether this State is beyond its northern limit has not yet been determined; but it is one of the diseases watched for in every nursery, though it is to be hoped that it will not make its appearance here.

Peach yellows, while present in the State, has not thus far shown itself in the nurseries. Possibly the disease may be present there in some cases, but if so, the trees are so young that it fails to show itself until they are beyond the nursery age.

Black knot is far too abundant in Massachusetts everywhere, but this disease, too, rarely shows itself on small trees. It has been found on nursery stock but a few times, and then always on trees which were almost beyond salable size. The treatment required has been to cut off and burn all affected branches at least a foot below the external marks of the disease.

No other fungous diseases of importance have thus far been met with in the nurseries of Massachusetts.

Among the insect pests the San José scale is perhaps the most generally distributed. It was the insect most universally present in the nurseries at the first annual inspection in 1902, and was being sent out with nearly every shipment made. To-day in nearly every one of these places it is difficult or impossible to find it, and when it is discovered it is in almost infinitesimal quantities, except on stock bought outside of the State after the last previous inspection. Here is now the chief danger to our nursery stock from this pest. Practically every nurseryman buys a part of the stock he sells, generally in some other State, and it is shipped into Massachusetts under certificate of inspection by the inspectors of that State. This certificate in many cases is not worth the paper it is written on, and the stock is frequently so badly infested as to attract the attention of persons who have no knowledge of scale insects. Fumigation or the destruction of all infested stock is required by the inspectors whenever this pest is found.

The oyster-shell scale is a common and sometimes serious pest in Massachusetts, but, while it often kills a single tree, it rarely seems to spread enough to destroy all the trees around. It is present in all parts of the State, and is sometimes found in the forests, far from any settlements, and therefore it hardly seems practicable to place this pest on the list of insects to be ruled against. Its presence on nursery stock is always called to the attention of the owner, however, and it is only the poorest kind of a nurseryman who will permit stock thus infested to be sent out.

What has been said of the oyster-shell scale also applies to the scurfy scale, though the latter insect is less abundant in Massachusetts than the former.

The gypsy moth is or soon will be one of the most difficult insects to inspect for in this State. Till last year it had not recovered from the repression produced by the efforts of the gypsy moth committee before the abandonment of the work, and few examples of it were met with in the nurseries. At the present time, however, it is extremely abundant in several nurseries, fairly so in several others, and is liable to occur in twenty-one nurseries in all. During the inspection last fall it was so abundant in one or two nurseries that a thorough cleaning out seemed to be almost impossible. For example, one small spruce tree less than four feet tall had sixteen egg masses on it, and the branches were so thick that several of the egg masses were missed at the first examination. Under such conditions as these, it is certain that at some time in the near future an egg mass will be overlooked and this pest be sent out on stock, unless fumigation of all stock in nurseries where the gypsy moth is found be made compulsory. This the nursery inspector has not thus far required, as it would certainly work some hardship in certain cases, and possibly might be difficult to enforce.

The brown-tail moth is almost as dangerous a pest as the gypsy moth, is present in many more of the nurseries, and during the earlier part of the inspection season is harder to find. After the leaves have fallen its tents are easily seen, but this is after the shipping season has begun and the inspection work for the year completed. As the caterpillars leave their tents to feed for a time after making them, there is no certainty that removal of the tents found by the inspectors will remove all the caterpillars, and there can be no certainty even that all the tents were found. The brown-tail moth has this year been found in nurseries in Lunenburg on the north-west, Clinton on the west and Whitman on the south. It is almost certain to be found each year in thirty-five nurseries, and is liable to be met with in forty-three others at any time. Under such inspection conditions as now exist, this pest, too, will sooner or later be sent out on nursery stock, in spite of all the efforts of the inspectors.

These are facts which must be met and squarely faced. The gypsy and brown-tail moths, in spite of the best work of which inspectors are capable, will sooner or later be carried to uninfested localities in this State or elsewhere on certificated nursery stock; and when other States realize this, it is quite probable that no Massachusetts stock will be permitted to enter those States, thus excluding us from a large and growing business. Shall anything be done to meet this condition, which, though only prospective now, may become an existent one at any moment? The only remedy which seems to be available is that of requiring the fumigation of all stock sold by nurseries where the gypsy and brown-tail moths occur; and whether this is feasible, is a question. The inspector recommends that the members of the Board of Agriculture, or some committee thereof, give this subject their careful consideration, that the best method of dealing with it may have been decided upon before actual cases requiring action shall have occurred.

FINANCIAL STATEMENT.

Appropriation,		$1,000 00
Compensation of State Nursery Inspector and three deputies,	$432 50	
Travelling and necessary expenses of inspector and deputies,	382 44	
Supplies (postage, etc.),	3 18	
Unexpended balance,	181 88	
		$1,000 00

That the duties of the inspectors have been rendered much easier and more pleasant by the attitude of the nurserymen themselves is a great satisfaction; and the thanks of the inspectors are herewith tendered to the nurserymen, to the members of the Board of Agriculture and to the secretary of the Board, for their kindly interest and sympathy with the work.

Respectfully submitted,

H. T. FERNALD,
State Nursery Inspector.

AMHERST, Dec. 23, 1904.

SIXTH SEMIANNUAL REPORT

OF THE

CHIEF OF THE CATTLE BUREAU

TO THE

MASSACHUSETTS
STATE BOARD OF AGRICULTURE.

JANUARY 10, 1905.

REPORT.

To the State Board of Agriculture.

The sixth semiannual report of the Chief of the Cattle Bureau, as required by section 3 of chapter 116 of the Acts of 1902, is herewith respectfully submitted to your honorable Board.

The law requires that a report shall be made semiannually, and in order to comply with the requirements of the statute one is submitted at the summer meeting of the Board, but it is necessarily brief and incomplete, as it can contain but a partial review of the year's work. The report made at the winter meeting is intended to be a full and detailed statement of the doings of the Cattle Bureau for the year.

The year of the Cattle Bureau commences the 16th of December of one year and closes the 15th of December the following one, in order to allow sufficient time for closing the books and preparing the report in season to have it ready for your consideration at this meeting.

The report now presented includes the work performed in connection with tuberculosis in cattle and glanders in horses during the entire year, together with a short account of such other diseases of a communicable or infectious character as may have been called to the attention of the Cattle Bureau and investigated by it.

A financial statement is submitted below, but, as the books are brought up only to December 15, it does not show the exact standing of the Bureau, but only the amount expended up to that time and the balance then on hand. When all outstanding accounts come in at the first of the year it will be found that a small deficiency in the appropriation exists, but this will be much less than it was at the beginning of 1903 and 1904.

The deficiencies for the two preceding years were caused largely by the extraordinary expenses required for the suppression of foot and mouth disease; in 1904 there was no expense necessary on this account. Upon the appearance of foot and mouth disease in the middle of November, 1902, all work in connection with tuberculosis had to be brought to a close; and in 1903 it was found necessary not to incur any further expense in connection with quarantining and killing tuberculous cattle after November 1 because of lack of funds; consequently, there had been no complete inspection of the herds of the State for a period of three years, from the autumn of 1901 to the autumn of 1904. It seemed only right and proper, therefore, in the past season, to allow the inspectors of animals to make a full and complete inspection of the neat cattle in their respective cities and towns, and to take care of all the tuberculous animals reported, even at the risk of causing a small deficit in the appropriation.

When the amount of work accomplished during the past year is realized, as shown in this report, it will be appreciated that it would be practically impossible to do more in proportion to the amount expended than has been done.

Sufficient remained of the appropriation Jan. 1, 1905, to pay all outstanding bills except those incurred for tuberculous cattle during the latter portion of the year, and enough remains to pay for part of them. Any deficiency that exists will be little more than the amounts received from the sales of hides and carcasses of condemned animals, sale of ear tags, testing cattle at Brighton for non-resident cattle owners, etc., — a sum amounting to $2,850.24, which under the general law must be turned over to the State Treasurer, and is not available for the use of the Cattle Bureau.

The accompanying financial statement gives in full the amounts available for the use of the Cattle Bureau and the expenditures made for different purposes: —

FINANCIAL STATEMENT.

Balance on hand, as per fourth semiannual report, Dec. 15, 1903,	$2,079 53	
Appropriated under chapter 135, Acts of 1904, for deficiency,	9,500 00	
Total available for accounts of 1903,	$11,579 53	
Appropriated under chapter 56, Acts of 1904, for work of 1904,	65,000 00	
Total to be accounted for,		$76,579 53

The expenditures during the year have been as follows: —

For 1,658 cattle condemned and killed as tuberculous,	$35,456 45	
For expenses of quarantine,	4 00	
For expenses of killing and burial,	7 50	
For salary of Chief of Bureau,	1,800 00	
For expenses of Chief of Bureau,	94 91	
For salary of clerk,	1,200 00	
For services of agents,	9,431 86	
For expenses of agents,	3,814 12	
For assistant clerks and stenographers,	1,865 25	
For printing, postage, stationery and other office expenses,	1,626 55	
For laboratory and experimental work, exclusive of glanders work,	99 68	
For implements, ear tags, mallein, tuberculin, etc.,	887 56	
For quarantine station expenses,	6,474 18	
For expenses of glanders work, including killing and burial and laboratory work,	8,869 58	
Total expenditures to Dec. 15, 1904,		71,631 64
Balance unexpended Dec. 15, 1904,		$4,947 89
Amount of deficiency appropriation for 1903 accounts, unexpended,		262 80
Net balance for 1904 account,		$4,685 09

Of the above expenditures there were paid for 295 cattle condemned and killed in 1903,	$6,765 50	
For sundry miscellaneous accounts of 1903,	4,551 23	
Total old bills of 1903 paid during 1904,		$11,316 73

Under the provisions of chapter 17 of the Resolves of 1904 there was paid to six owners of animals slaughtered subsequent to April 11, 1903, by order of the State authority, for the purpose of exterminating foot and mouth disease, thirty per cent of the appraised value of such animals, as follows: —

35 cows, average $45.57, appraised for	$1,595 00
1 bull, appraised for	30 00
7 calves, average $5, appraised for	35 00
1 sheep, appraised for	6 00
9 swine, average $6.55, appraised for	59 00
53 animals, total appraisal,	$1,725 00
Seventy per cent paid by the United States,	1,207 50
Difference, thirty per cent, paid by State,	$517 50

There was also paid, under the provisions of chapter 29, Resolves of 1904, to five owners of animals killed for the purpose of exterminating foot and mouth disease, who, through misunderstanding on their part, received no compensation from the State when other owners were paid under the provisions of chapter 83, Resolves of 1903, as follows: —

64 cows, 2 bulls, average $44.15, appraised for	$2,914 28
Seventy per cent paid by the United States,	2,040 00
Difference, thirty per cent, paid by State,	$874 28
Total on account of foot and mouth disease paid in 1904,	$1,391 78

By the terms of the two resolves authorizing them, these payments were to be made from the unexpended balance of the appropriation made for foot and mouth disease by chapter 83 of the Resolves of 1903.

This balance, as per fourth semiannual report of this Bureau, was, on Dec. 15, 1903,	$1,755 02
Paid under chapters 17 and 29, Resolves of 1904, as above,	1,391 78
Balance of appropriation under chapter 83, Resolves of 1903,	$363 24

From the sale of hides and carcasses of condemned animals, sale of ear tags, testing cattle at Brighton for non-resident owners, etc., there has been received and paid to State Treasurer $2,850.24.

The average price paid for condemned cattle during the year was $21.39.

For branding the carcasses of animals slaughtered for food, under the provisions of chapter 220, Acts of 1903, 30 stamps were furnished to the boards of health of 25 different towns.

An annual inspection of animals and premises was called for in the autumn of 1904 by the following letter of instructions: —

COMMONWEALTH OF MASSACHUSETTS,
CATTLE BUREAU OF THE STATE BOARD OF AGRICULTURE,
ROOM 138, STATE HOUSE, BOSTON, Sept. 15, 1904.

DIRECTIONS TO INSPECTORS OF ANIMALS.

Inspectors of animals are hereby directed to make a general inspection of the neat stock in their respective towns, and incidentally other farm animals, to commence October 1 and to be completed before the fifteenth day of November, as required by chapter 90 of the Revised Laws.

Wherever inspectors examine animals and find them free from contagious disease they will give owners certificates of health, as provided for in section 18 of the law, from the book of blanks (Form No. 2) furnished for that purpose. Books will also be provided (Form No. 1) for carrying out the provisions of sections 17 and 24 of chapter 90 of the Revised Laws.

Inspectors of animals newly appointed this year will make a full and complete report on every place inspected, including all dimensions and measurements provided for on the blank. Inspectors who have done this work in previous years may omit the dimensions of the size of the building in which cattle are stabled, the dimensions of the size of stable or part of building allotted to cattle, the width of the space in front of the cattle and the width of the space behind the cattle, saying, in answer to these questions, "the same as last year," unless improvements or alterations have been made, in which case dimensions are to be recorded. All other questions as to the light, ventilation, sanitary surroundings and water supply, as well as the number of cattle in the stable, are to be answered fully by all the inspectors.

Inspectors of animals are not to quarantine any cattle as tuberculous unless they show sufficient evidence of disease to make it possible to condemn them on a physical examination. The only exception to be made is in case a milch cow shows evidence of tuberculosis of the udder; such an animal can be quarantined and the duplicate notice sent to this office.

It is also requested that, if cases of tuberculosis in animals are found, inspectors keep a record of them for a few days, and then when animals are quarantined several can be quarantined at once and duplicates sent here; so that the agent of the Cattle Bureau can see a number at one visit, instead of having to go every two or three days to see one animal at a time, thus avoiding running up expenses as much as possible.

It is also the duty of inspectors of animals to quarantine cattle brought into this State from without the limits of the Commonwealth, if the owner has not had a permit from this Bureau, the same to remain in quarantine until this office is furnished with a satisfactory certificate of tuberculin test.

As section 24 requires that the results of the inspection shall be incorporated in the annual report of the Chief of the Cattle Bureau to the State Board of Agriculture, it will be seen that it is necessary for the returns to be at this office by November 15, in order to prepare them for publication.

The necessary books for the inspection will be forwarded at once by express. Please report immediately if not received by September 25.

AUSTIN PETERS,
Chief of Cattle Bureau.

Section 24 of chapter 90 of the Revised Laws provides that "inspectors shall, in addition to their inspections of animals for contagious diseases, examine the barns, stables or other enclosures in which neat cattle are kept, with reference to their situation, cleanliness, light, ventilation and water supply, and the general condition and cleanliness of the said neat cattle, and shall make a detailed report, with names and residences of the owners, to the board [of Cattle Commissioners], which shall embody it in its annual report to the general court."

As it seems to be the purpose of the law that an annual statement of the work of the inspectors of animals in regard to the sanitary surroundings of the neat cattle of the State shall be given, it has been customary to include a tabulated abstract of their doings in the final report of the Cattle Bureau for the year. The following table shows the work done by the inspectors of animals at the time of the annual inspection in the autumn of 1904: —

Report of Inspection of Animals, Stables, etc., required by Section 24, Chapter 90, Revised Laws.

CITY OR TOWN.	Number Herds inspected.	Number Neat Cattle inspected.	Number Milch Cows inspected.	Number Herds kept Clean and in Good Condition.	Number Sheep inspected.	Number Swine inspected.	Number Goats inspected.	Number Stables inspected.	Number Stables well located.	Number Stables well lighted.	Number Stables well ventilated.	Number Stables kept Clean.	Number Stables with Good Water Supply.	Number Stables Improved since Last Report.
Abington, . . .	105	330	252	95	4	128	-	108	*7	75	68	100	105	5
Acton, ...	119	1,100	756	116	19	112	-	129	*22	121	126	127	123	3
Acushnet, . . .	185	606	304	131	-	327	-	136	115	124	119	125	131	2
Adams, ...	78	953	597	71	122	385	-	*62	*50	*54	*58	*58	*61	-
Agawam, . . .	179	1,600	953	168	-	699	-	179	*28	149	168	175	176	8
Alford, ...	50	382	270	45	151	137	-	56	35	43	54	55	30	-
Amesbury, . . .	79	435	307	69	10	117	-	79	*1	67	67	70	78	-
Amherst, ...	106	1,454	1,045	102	45	312	-	106	*1	87	88	103	98	3
Andover, ...	137	1,145	809	122	2	734	-	137	*3	127	133	135	128	-
Arlington, . . .	84	212	165	82	1	28	-	84	*5	78	79	80	88	1
Ashburnham, . .	116	623	363	102	33	244	-	*8	*5	*4	*4	*4	*5	3
Ashby, ...	120	605	405	108	21	161	-	120	110	106	117	115	117	2
Ashfield, ...	169	1,646	740	158	966	352	17	185	145	145	157	180	183	4
Ashland, ...	87	495	199	77	-	128	-	87	*8	81	87	84	80	1
Athol, ...	125	799	382	84	85	318	-	124	*8	74	57	110	116	3
Attleborough, . .	174	1,058	746	171	-	309	-	177	*12	178	175	172	177	2

Auburn, ...	69	788	437	62	1	840	10	69	*10	59	56	66	67	-
Avon, ...	58	160	139	51	6	54	-	58	42	30	43	47	58	-
Ayor, ...	28	143	86	25	-	67	-	29	*2	26	27	26	26	-
Barnstable, . . .	240	703	379	228	62	660	19	*6	*6	*6	*6	*6	*6	1
Barre, ...	75	1,954	885	62	12	326	-	72	*8	61	70	68	70	5
Becket, ...	90	656	319	85	177	103	150	90	*1	90	90	90	90	-
Bedford, ...	66	700	419	62	5	572	5	66	47	66	66	65	66	-
Belchertown, . . .	290	2,255	1,332	265	88	589	-	316	256	299	316	312	315	4
Bellingham, . . .	92	550	358	84	-	290	-	92	*83	57	86	90	91	4
Belmont, ...	36	216	164	36	-	57	-	†-	†-	†-	†-	†-	†-	†-
Berkley, ...	113	488	286	111	-	222	1	120	104	107	115	117	119	-
Berlin, ...	90	710	408	84	7	92	-	91	*2	80	83	86	88	-
Bernardston, . . .	90	864	427	87	283	269	1	90	†-	44	2	88	81	-
Beverly, ...	45	607	438	41	-	14	1	45	*1	39	44	43	24	-
Billerica, ...	142	968	653	115	1	377	1	*4	*2	*1	*1	*1	*1	2
Blackstone, . . .	102	465	308	101	-	241	-	102	72	97	100	102	100	1
Blandford, . . .	108	1,113	504	92	287	110	-	121	*86	*105	*117	*117	*108	1
Bolton, ...	104	868	†-	†-	12	131	5	*1	*1	*1	*1	*1	*1	1
Boston, ...	257	1,076	926	201	206	387	-	267	*2	101	*66	181	*188	1
Bourne, ...	68	178	96	47	-	14	-	66	52	66	66	66	66	1
Boxborough, . . .	46	666	312	39	22	125	-	48	*1	43	44	46	47	-

* Incomplete report. † No report.

Report of Inspection of Animals, Stables, etc. — Continued.

CITY OR TOWN.	Number Herds inspected.	Number Neat Cattle inspected.	Number Milch Cows inspected.	Number Herds kept Clean and in Good Condition.	Number Sheep inspected.	Number Swine inspected.	Number Goats inspected.	Number Stables inspected.	Number Stables well located.	Number Stables well lighted.	Number Stables well ventilated.	Number Stables kept Clean.	Number Stables with Good Water Supply.	Number Stables improved since Last Report.
Boxford, ...	64	620	324	52	-	132	-	*2	*2	*2	*2	*2	*2	-
Boylston, . . .	66	731	441	58	6	421	5	68	56	66	66	66	67	3
Braintree, . . .	91	451	340	88	3	180	-	91	*12	89	89	90	90	3
Brewster, . . .	92	185	97	88	88	91	-	91	72	78	81	83	91	-
Bridgewater, . . .	178	844	512	126	51	732	-	*3	*2	*1	*2	*3	*2	1
Brimfield, . . .	107	1,177	380	108	130	142	1	113	97	108	110	110	110	-
Brockton, . . .	135	1,058	729	125	6	1,015	7	137	120	125	125	113	136	2
Brookfield, . . .	147	961	534	109	36	272	-	144	†-	98	122	115	112	2
Brookline, . . .	49	257	184	†-	-	60	50	*27	*19	*21	*18	*24	*26	-
Buckland, . . .	196	1,059	568	108	200	246	-	184	112	114	125	112	131	1
Burlington, . . .	46	509	266	42	-	2,270	-	46	*34	46	46	46	46	-
Cambridge, . . .	80	129	121	29	-	-	-	80	†-	80	80	80	80	-
Canton, ...	121	567	420	99	41	448	-	*10	*8	*10	*10	*9	*9	1
Carlisle, ...	59	572	369	48	3	84	-	60	*43	46	57	44	59	-
Carver, ...	91	183	91	77	17	100	3	91	*7	85	89	85	85	-
Charlemont, . . .	85	902	528	59	208	178	1	85	*-	40	71	62	85	2

Charlton, . . .	185	1,772	980	171	5	380	8	*86	*65	*85	*68	*83	*68	4
Chatham, . . .	74	169	14	48	-	80	-	74	†-	83	28	74	70	-
Chelmsford, . . .	64	664	482	57	1	85	-	65	*2	57	62	56	59	-
Chelsea, ...	24	181	174	24	-	-	4	25	24	23	23	22	25	1
Cheshire, . . .	62	981	638	56	60	175	5	*60	*29	*30	*39	*59	*58	1
Chester, ...	98	790	384	95	460	222	1	182	*15	41	76	94	95	1
Chesterfield, . . .	103	1,094	458	87	2	176	-	141	60	81	106	122	135	1
Chicopee, . . .	81	666	321	48	-	313	-	86	60	54	75	67	68	-
Chilmark, . . .	62	244	90	61	2,308	54	-	56	51	48	56	56	56	1
Clarksburg, . . .	54	360	132	34	-	78	-	*5	*5	*4	*4	*2	*2	-
Clinton, ...	39	92	71	32	-	85	-	39	†-	29	30	36	38	-
Cohasset, . . .	106	281	224	33	-	129	2	106	72	62	9	73	8	4
Colrain, ...	180	2,073	817	158	894	511	2	179	*20	*17	*18	*22	174	8
Concord, ...	157	1,691	1,024	148	4	629	10	164	151	143	143	159	162	4
Conway, ...	95	1,474	695	93	356	446	-	97	†-	*59	80	94	96	-
Cottage City, . . .	36	145	102	35	7	116	-	37	34	33	35	35	31	2
Cummington, . . .	101	854	440	99	154	98	19	106	*9	61	96	86	100	-
Dalton, ...	80	603	190	17	143	207	-	37	23	37	37	37	37	2
Dana, ...	75	386	*59	74	8	118	-	75	*1	59	72	74	74	3
Danvers, ...	73	878	406	44	-	96	-	72	†-	†-	†-	†-	†-	†-
Dartmouth, . . .	284	2,213	1,560	218	6	763	-	*175	*97	*142	*122	*171	*161	4

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Report of Inspection of Animals, Stables, etc. — Continued.

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Dedham, ...	96	589	449	93	-	357	-	*6	*5	*3	*2	*5	*-	1
Deerfield, . . .	125	879	471	111	-	429	5	*125	*75	*71	*115	*116	*104	7
Dennis, ...	98	215	125	72	-	119	-	98	*6	*58	*68	*66	*84	-
Dighton, ...	106	478	329	103	77	197	-	106	104	108	100	106	107	4
Douglas, ...	115	384	150	94	-	224	-	115	*18	79	111	101	118	-
Dover, ...	63	648	461	42	35	249	-	64	58	36	27	54	62	1
Dracut, ...	151	1,237	966	121	-	1,079	3	164	143	66	107	92	145	4
Dudley, ...	93	1,158	700	83	4	60	2	*2	†-	†-	†-	†-	†-	2
Dunstable, . . .	32	372	227	31	-	66	-	33	25	30	33	31	32	2
Duxbury, ...	131	401	264	127	11	243	1	*14	*11	*11	*11	*11	*11	3
East Bridgewater, .	179	799	559	166	-	418	-	179	*9	175	175	174	177	20
East Longmeadow, .	84	579	352	81	-	137	-	84	61	47	82	84	84	-
Eastham, ...	51	136	87	48	-	68	1	*36	†-	*24	*23	*34	*22	-
Easthampton, . .	126	988	551	126	1	308	-	*1	*1	*1	*1	*1	*1	1
Easton, ...	184	871	517	170	-	39	2	182	*1	*5	*5	*5	*5	2
Edgartown, . . .	54	256	169	50	658	193	12	54	*44	52	53	51	50	5

Egremont, . . .	95	916	682	92	260	224	26	105	†-	94	94	94	94	5
Enfield, ...	94	608	350	94	18	142	8	98	*6	79	88	89	92	3
Erving, ...	44	188	95	36	-	91	-	44	*14	42	42	43	41	3
Essex, ...	70	683	406	67	3	53	2	71	32	69	70	69	70	2
Everett, ...	31	222	208	31	-	506	-	30	25	26	29	28	21	-
Fairhaven, . . .	110	537	350	45	-	19	-	110	*5	*35	*24	*66	*2	6
Fall River, . . .	171	789	554	150	1	456	-	174	146	122	159	144	174	9
Falmouth, . . .	165	424	285	161	-	225	-	*21	*20	*16	*21	*19	*17	-
Fitchburg, . . .	142	1,028	510	100	15	325	-	142	*4	77	91	100	139	1
Florida	67	502	274	67	3	253	-	75	*1	75	75	75	75	-
Foxborough, . . .	132	580	356	123	-	345	30	131	121	125	127	124	128	2
Framingham,* . .	104	1,190	741	87	10	144	150	112	105	91	105	110	99	-
Franklin, . . .	129	880	617	118	4	47	-	*15	*4	*9	*9	*9	*9	2
Freetown, . . .	114	341	206	88	7	138	-	120	94	69	69	104	72	4
Gardner, ...	95	695	425	79	75	190	-	*53	*27	*19	*23	*31	*29	2
Gay Head, . . .	23	88	22	23	-	49	-	23	17	5	7	23	23	-
Georgetown, . . .	88	877	188	85	41	124	65	86	*3	72	85	82	85	-
Gill, ...	69	898	497	46	112	228	-	74	*3	45	70	60	67	9
Gloucester, . . .	125	727	545	90	-	287	-	134	105	75	68	79	46	-
Goshen, ...	45	459	167	36	64	82	-	†-	†-	†-	†-	†-	†-	†-
Gosnold, ...	8	50	31	7	2,326	21	-	8	†-	6	8	7	7	-

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Report of Inspection of Animals, Stables, etc. — Continued.

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Grafton, ...	147	1,523	857	133	134	292	1	155	118	133	132	136	143	-
Granby, ...	123	1,399	962	114	7	275	1	135	*56	108	131	118	132	-
Granville,* . . .	119	874	499	117	45	358	-	119	†-	116	117	118	118	5
Great Barrington, .	149	1,435	828	141	17	559	-	*130	*84	*127	*130	*128	*129	-
Greenfield, . . .	150	1,314	610	145	350	527	-	149	*4	146	147	146	149	-
Greenwich, . . .	75	471	211	71	-	113	-	78	76	60	78	75	76	5
Groton, ...	145	1,086	609	83	89	191	57	149	104	104	137	91	61	7
Groveland, . . .	56	329	160	54	6	55	-	57	†-	51	55	51	55	-
Hadley, ...	216	1,819	789	194	104	739	-	*113	*21	*96	*107	*108	*112	7
Halifax, ...	67	204	138	67	7	78	-	68	55	66	68	68	68	-
Hamilton, . . .	58	338	184	52	-	167	2	*10	*8	*7	*8	*9	*9	6
Hampden, . . .	82	754	347	78	-	68	-	82	*8	*12	*15	*15	*12	8
Hancock, . . .	68	870	441	58	735	195	-	98	45	41	92	78	97	-
Hanover, . . .	119	310	250	117	7	209	-	119	108	119	119	119	119	2
Hanson, ...	91	187	158	89	-	219	1	90	70	90	90	87	90	1
Hardwick, . . .	118	2,266	1,188	89	16	297	-	*4	*1	*1	*1	*1	*1	-

Harvard, ...	148	1,676	888	77	116	181	-	156	145	108	148	114	129	4
Harwich, . . .	129	237	177	129	1	145	5	*86	*14	*5	*17	*18	*18	5
Hatfield, ...	123	840	290	120	-	218	-	128	119	122	122	128	123	-
Haverhill, . . .	245	1,580	911	152	7	294	19	246	297	91	86	189	115	4
Hawley, ...	80	817	439	78	180	143	-	82	*2	76	82	79	82	4
Heath, ...	90	1,077	455	86	247	189	-	119	*79	115	119	119	116	-
Hingham, . . .	158	665	441	158	12	260	-	160	*13	*15	*15	*15	*15	-
Hinsdale, . . .	97	899	495	89	70	183	3	97	†-	93	92	96	93	1
Holbrook, . . .	78	218	167	70	1	361	6	*68	*48	*62	*63	*64	*65	-
Holden, ...	120	868	612	107	-	259	1	120	87	110	115	111	106	1
Holland, ...	39	249	80	88	85	129	-	37	*6	21	35	36	36	1
Holliston, . . .	122	701	541	118	-	120	-	122	*1	116	116	109	111	4
Holyoke, ...	78	731	441	64	2	220	4	*62	*1	*2	*2	*44	*35	4
Hopedale, . . .	30	114	89	28	-	68	-	31	*10	27	27	29	30	5
Hopkinton, . . .	147	788	314	110	-	194	86	147	*3	106	101	115	140	6
Hubbardston, . .	105	988	555	100	55	216	320	105	82	101	101	102	102	1
Hudson, ...	45	384	222	44	-	103	-	45	42	42	38	41	43	3
Hull, ...	15	55	46	12	-	-	-	*1	*1	*-	*-	*1	*-	-
Huntington, . . .	102	837	237	88	172	248	-	109	63	94	96	96	99	1
Hyde Park, . . .	18	62	52	16	-	-	-	18	14	12	5	18	18	-
Ipswich, ...	135	981	582	132	4	323	-	141	*15	138	140	139	141	-

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Kingston, ...	94	297	168	90	6	222	5	99	78	87	90	94	99	6
Lakeville, ...	95	424	208	77	11	220	8	95	*9	77	86	65	94	5
Lancaster, ...	95	718	465	80	5	220	-	97	*13	74	92	86	69	2
Lanesborough, . .	107	1,135	638	106	18	241	-	107	*4	107	107	107	106	-
Lawrence, ...	12	75	58	11	-	89	-	*1	*1	*1	*1	*1	*1	-
Lee, ...	189	1,020	628	176	290	896	8	197	*21	184	195	191	140	-
Leicester,† . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lenox, ...	20	380	170	19	28	-	-	*17	*1	*1	*–	*1	*1	-
Leominster, . . .	94	969	619	87	20	282	-	110	66	64	88	64	84	-
Leverett, ...	78	441	266	61	-	259	-	78	*8	67	71	71	67	-
Lexington, . . .	52	929	687	49	-	145	2	*1	*1	*1	*1	*1	*1	-
Leyden, ...	68	758	816	62	278	171	-	88	65	41	78	81	83	-
Lincoln, ...	91	815	642	88	18	449	2	†–	†–	†–	†–	†–	†–	†–
Littleton, ...	92	1,517	822	90	-	95	17	92	†–	†–	†–	†–	†–	†–
Longmeadow, . .	52	261	189	51	-	407	-	60	45	51	54	58	58	1
Lowell, ...	42	271	241	84	-	219	-	42	85	29	36	31	33	1

Ludlow, ...	129	856	650	110	-	325	-	129	*8	96	115	119	106	10
Lunenburg, . . .	121	1,082	658	119	8	294	-	121	†-	111	120	119	121	-
Lynn, ...	90	337	247	84	8	165	4	92	88	69	91	68	92	8
Lynnfield, . . .	30	351	189	25	-	59	1	30	29	30	30	30	30	-
Malden, ...	17	108	97	18	-	-	-	17	*6	10	11	16	16	1
Manchester, . . .	29	114	92	26	2	57	-	31	†-	24	23	23	30	-
Mansfield, . . .	126	300	201	97	-	262	69	134	115	79	87	89	119	14
Marblehead, . . .	45	327	240	29	-	255	2	*18	*4	*6	*4	*13	*2	7
Marion, ...	47	144	106	40	1	132	-	47	*39	36	36	36	47	-
Marlborough, . . .	170	1,069	756	168	-	588	7	174	136	149	167	160	169	1
Marshfield, . . .	146	546	339	142	251	255	1	150	124	68	100	135	141	3
Mashpee, . . .	20	32	17	18	-	59	-	*2	*3	*2	*2	*3	*2	-
Mattapoisett, . . .	89	325	207	85	2	377	-	88	86	77	86	88	88	1
Maynard,† . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Medfield, ...	75	617	391	70	-	587	-	94	91	87	91	92	93	5
Medford, ...	54	355	262	50	-	83	8	62	56	61	61	61	62	8
Medway, ...	118	608	340	94	-	168	2	123	115	101	113	100	115	-
Melrose, ...	46	156	89	35	-	1	-	*4	*4	*1	*1	*1	*4	-
Mendon, ...	96	626	398	85	-	175	2	98	*15	63	84	80	95	4
Merrimac, . . .	55	360	233	44	2	108	-	57	48	47	*21	53	*34	1
Methuen, . . .	166	1,545	1,110	118	172	525	-	166	†-	†-	†-	†-	†-	†-

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Middleborough, . .	311	1,097	626	251	27	623	8	313	*222	*258	*246	*232	*266	7
Middlefield, . . .	50	587	175	50	309	82	25	56	*2	56	56	56	55	-
Middleton, . . .	56	324	228	43	1	428	14	56	†-	†-	†-	†-	†-	†-
Milford, ...	143	510	358	122	1	351	8	142	*19	137	136	131	141	14
Millbury, . . .	133	926	621	117	-	152	53	134	113	121	127	126	130	5
Millis, ...	51	623	322	49	-	-	-	50	*3	34	48	47	50	2
Milton, ...	109	910	751	108	-	265	-	109	†-	108	108	108	109	-
Monroe, ...	23	153	85	23	42	58	1	25	15	24	25	25	25	1
Monson, ...	121	1,181	757	*92	53	212	9	121	109	114	114	108	120	4
Montague, . . .	142	1,038	583	121	65	406	-	*18	*6	*7	*6	*8	*10	16
Monterey, . . .	72	652	348	72	167	242	-	†-	†-	†-	†-	†-	†-	†-
Montgomery, . . .	43	442	235	38	74	72	-	45	23	43	45	44	45	1
Mount Washington, .	17	92	17	17	-	41	4	17	*3	6	14	16	14	-
Nahant, ...	9	27	24	9	-	3	-	9	6	9	9	9	9	2
Nantucket, . . .	52	480	279	49	-	189	3	52	44	48	52	51	52	-
Natick, ...	59	588	406	48	-	210	-	60	55	34	81	50	56	1

Needham, . . .	91	787	580	85	88	87	-	95	89	47	65	89	95	-
New Ashford, . .	94	189	123	22	202	29	-	24	17	23	22	22	22	-
New Bedford, . .	88	581	315	86	-	176	-	88	*1	49	69	81	86	-
New Braintree, . .	77	1,521	1,096	76	-	208	1	77	69	72	75	75	77	1
New Marlborough, .	116	1,564	585	96	284	160	11	119	*61	91	78	114	117	7
New Salem, . . .	119	568	254	108	98	247	-	121	104	120	119	120	117	1
Newbury, . . .	122	1,711	868	86	72	430	-	184	152	116	148	184	97	5
Newburyport, . .	87	457	285	85	-	257	-	92	83	76	78	90	84	-
Newton, ...	218	1,155	*66	215	-	-	-	224	*4	205	201	197	224	2
Norfolk, ...	59	364	232	55	-	162	-	*4	*2	*2	*2	*2	*2	3
North Adams, . .	55	673	374	55	79	141	-	55	*12	*12	*13	*13	*13	2
North Andover, . .	68	1,063	720	65	-	80	-	69	67	67	69	68	69	2
North Attleborough, .	119	646	523	101	-	274	-	119	106	82	90	94	115	2
North Brookfield, . .	142	1,361	810	98	-	352	-	143	55	94	141	105	128	-
North Reading, . .	62	519	304	61	8	85	-	62	55	61	62	58	62	7
Northampton, . .	121	910	581	110	-	237	-	121	†-	102	119	117	121	-
Northborough, . .	129	1,180	774	111	1	117	7	133	118	101	106	114	131	1
Northbridge, . . .	92	556	356	88	23	231	-	100	*64	96	97	96	100	-
Northfield, . . .	83	581	276	58	67	101	-	*82	*75	*66	*69	*73	*73	1
Norton, ...	148	447	303	145	3	228	-	146	*9	188	140	139	142	1
Norwell, ...	103	241	182	98	46	158	6	103	76	80	101	99	103	1

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Norwood, ...	89	459	*272	85	-	81	-	96	89	94	96	95	96	-
Oakham, ...	59	644	342	56	-	84	-	60	45	47	50	57	48	4
Orange, ...	185	1,115	591	164	39	531	1	191	*19	166	178	175	189	-
Orleans, ...	88	218	150	81	87	80	-	89	68	78	77	71	88	1
Otis, ...	102	647	300	101	237	149	-	105	*7	105	105	105	105	-
Oxford, ...	86	599	329	83	22	184	551	86	*44	75	85	82	84	-
Palmer, ...	149	1,009	278	145	-	-	-	146	*3	*61	*67	*120	*120	-
Paxton, ...	62	615	419	57	28	65	-	62	52	50	55	59	62	1
Peabody, . . .	54	854	755	48	10	429	-	53	49	48	58	47	53	5
Pelham, ...	45	209	138	42	9	58	-	45	*1	24	31	40	42	-
Pembroke, . . .	99	280	149	96	5	134	-	98	*10	97	97	96	96	8
Pepperell, . . .	140	858	482	129	9	188	-	150	145	136	143	140	148	2
Peru, ...	47	426	252	41	70	68	-	48	27	45	46	45	41	-
Petersham, . . .	112	872	429	88	72	283	-	113	89	64	64	78	108	4
Phillipston, . . .	71	561	321	65	2	142	-	70	89	87	25	69	69	1
Pittsfield, . . .	65	1,258	725	50	8	271	8	*3	*3	*2	*1	*3	*3	2

Plainfield, . . .	72	729	313	53	225	170	1	98	44	47	80	76	92	1
Plymouth, . . .	172	640	842	94	21	800	241	174	47	70	77	82	150	9
Plympton, . . .	62	284	188	58	2	81	2	68	52	59	50	62	42	1
Prescott, ...	65	516	270	63	23	167	-	*5	*3	*4	*3	*5	*4	-
Princeton, . . .	92	1,120	602	60	69	159	-	92	79	82	71	73	90	2
Provincetown, . .	12	96	57	9	1	17	-	12	8	12	1	10	9	1
Quincy, ...	146	699	289	131	-	115	-	159	118	106	113	189	186	1
Randolph, . . .	98	842	243	87	-	1,154	6	94	*3	74	86	90	*9	-
Raynham, . . .	57	438	295	52	1	180	1	*5	†-	*2	*2	*2	*1	2
Reading, ...	85	364	296	88	-	90	5	*8	*4	*5	*5	*5	*5	2
Rehoboth, . . .	258	1,780	1,157	246	15	848	-	324	289	227	314	317	324	2
Revere, ...	32	142	181	25	-	800	-	32	*6	30	29	82	25	-
Richmond, . . .	92	615	344	92	672	276	-	91	*1	*1	*1	*1	*1	1
Rochester, . . .	61	256	157	60	-	211	-	*5	*3	*2	*3	*3	*2	-
Rockland, . . .	109	263	182	70	-	46	-	108	*50	82	81	76	105	2
Rockport, . . .	40	196	157	40	-	7	-	40	34	36	40	40	40	-
Rowe, ...	73	651	264	73	171	172	-	*2	*1	*1	*2	*2	*2	2
Rowley, ...	76	644	309	43	22	115	-	76	46	54	59	57	70	3
Royalston, . . .	113	928	423	102	73	270	-	112	*63	*85	*87	*84	*84	3
Russell, ...	43	227	112	81	96	105	-	48	33	34	44	37	45	2
Rutland, ...	113	1,096	576	103	-	182	-	*43	*24	*26	*31	*30	*32	14

* Incomplete report.

† No report.

Report of Inspection of Animals, Stables, etc. — Continued.

CITY OR TOWN.	Number Herds inspected.	Number Neat Cattle inspected.	Number Milch Cows inspected.	Number Herds kept Clean and in Good Condition.	Number Sheep inspected.	Number Swine inspected.	Number Goats inspected.	Number Stables inspected.	Number Stables well located.	Number Stables well lighted.	Number Stables well ventilated.	Number Stables kept Clean.	Number Stables with Good Water Supply.	Number Stables improved since Last Report.
Salem, ...	13	308	185	10	-	94	-	15	†-	6	5	10	13	-
Salisbury, . . .	111	602	*255	104	20	136	-	115	†-	107	108	105	104	6
Sandisfield, . . .	107	995	*440	104	49	142	2	107	†-	101	98	95	106	-
Sandwich, . . .	88	274	61	85	23	109	-	†-	†-	†-	†-	†-	†-	†-
Saugus, ...	42	844	711	40	-	231	-	48	44	45	45	48	48	-
Savoy, ...	98	725	*362	84	66	170	1	104	†-	44	43	85	88	-
Scituate, ...	124	870	247	121	23	102	-	126	112	85	117	122	125	-
Seekonk, ...	146	1,278	*523	122	23	1,745	-	156	†-	*78	*95	*98	*129	1
Sharon, ...	76	332	237	71	-	69	-	78	*16	*15	*15	*15	*16	1
Sheffield, ...	190	2,237	*926	*120	95	466	-	219	*143	*139	*212	*210	*158	2
Shelburne, . . .	105	1,633	632	90	657	302	3	100	*8	95	102	100	102	1
Sherborn, . . .	114	1,090	*608	106	-	533	14	116	107	95	100	107	96	3
Shirley, ...	53	416	249	47	6	49	-	59	55	51	51	55	59	-
Shrewsbury, . . .	158	1,494	1,009	157	1	671	-	160	144	159	158	155	157	2
Shutesbury, . . .	48	158	87	40	8	42	-	43	42	48	48	42	43	-
Somerset, . . .	71	563	389	68	-	611	-	71	63	69	71	69	66	-

Somerville, . . .	46	134	124	35	2	169	8	46	20	28	18	31	46	16
South Hadley, . .	127	1,258	979	87	9	276	-	126	*8	*7	*9	*9	*11	-
Southampton, . .	147	1,045	758	142	78	187	-	148	107	146	148	147	148	1
Southborough, . .	105	1,231	896	88	22	151	46	110	99	92	99	94	102	-
Southbridge, . . .	80	745	*441	76	45	191	-	80	†-	74	76	76	80	1
Southwick, . . .	131	1,063	615	125	371	310	20	131	*12	122	126	123	125	-
Spencer, ...	142	1,594	871	135	16	435	10	142	*9	*119	*119	*112	*121	-
Springfield, . . .	163	520	335	138	2	1,391	1	163	*8	106	98	138	86	6
Sterling, ...	148	1,647	*820	137	89	135	-	149	†-	111	133	141	144	-
Stockbridge, . . .	119	894	486	116	233	395	7	119	†-	*78	*90	*91	*92	2
Stoneham, . . .	72	304	265	59	-	130	7	76	52	85	39	55	57	-
Stoughton, . . .	127	515	826	90	-	33	-	132	*60	70	110	94	129	4
Stow, ...	99	1,033	552	70	35	258	-	128	115	77	112	98	125	-
Sturbridge, . . .	23	252	121	20	5	46	-	22	†-	*15	*13	*13	22	-
Sudbury, . . .	105	1,291	759	†-	-	137	10	115	*91	*103	†-	*99	*83	-
Sunderland, . . .	71	684	412	26	8	357	-	*1	*1	*–	*1	*–	*–	-
Sutton, ...	181	1,257	828	168	36	326	8	136	140	126	178	157	170	8
Swampscott, . . .	22	87	74	19	-	142	-	23	14	18	22	17	20	-
Swansea, ...	138	1,058	672	136	2	418	-	139	130	130	137	129	134	-
Taunton, ...	210	1,092	894	209	8	989	-	*65	*1	*1	*1	*1	*1	-

* Incomplete report.

† No report.

Report of Inspection of Animals, Stables, etc. — Continued.

CITY OR TOWN.	Number Herds inspected.	Number Neat Cattle inspected.	Number Milch Cows inspected.	Number Herds kept Clean and in Good Condition.	Number Sheep inspected.	Number Swine inspected.	Number Goats inspected.	Number Stables inspected.	Number Stables well located.	Number Stables well lighted.	Number Stables well ventilated.	Number Stables kept Clean.	Number Stables with Good Water Supply.	Number Stables improved since Last Report.
Templeton, ...	119	612	378	110	5	164	-	119	96	97	106	111	112	2
Tewksbury, ...	133	870	551	122	-	237	2	137	97	63	106	116	115	2
Tisbury, ...	20	71	42	19	-	34	2	20	†-	20	17	17	17	1
Tolland, ...	51	562	263	21	3	119	1	69	42	30	45	49	47	3
Topsfield, . . .	63	702	428	59	-	92	2	68	*18	58	60	60	66	2
Townsend, . . .	137	554	371	102	4	361	-	*12	*6	*7	*7	*7	*8	4
Truro, ...	70	288	142	69	-	55	-	70	46	69	69	68	70	2
Tyngsborough, . .	57	460	241	4	23	256	-	61	40	29	45	38	45	17
Tyringham, . . .	53	523	253	44	158	111	5	69	61	58	66	67	67	5
Upton, ...	114	634	331	17	3	264	-	117	*20	*42	*13	*15	*91	2
Uxbridge, . . .	144	891	538	137	50	262	48	144	102	134	133	133	141	5
Wakefield, . . .	88	351	296	86	2	138	-	99	77	79	94	90	96	1
Wales, ...	58	277	117	24	22	116	-	58	*2	44	55	56	40	1
Walpole, ...	89	537	*82	82	13	822	5	88	*27	*68	*70	*70	*76	5
Waltham, . . .	83	675	557	80	-	709	-	85	23	19	22	80	27	-

Ware, ...	135	1,153	714	45	1	379	-	134	114	24	52	10	123	3
Wareham, . . .	80	271	185	78	25	110	2	80	49	80	79	77	80	-
Warren, ...	135	1,374	962	126	18	337	1	146	*-	*81	*76	*127	*118	3
Warwick, . . .	81	364	206	56	32	128	-	84	75	78	80	83	79	-
Washington, . . .	55	805	300	1	164	174	157	57	*6	*30	*43	*4	*21	3
Watertown, . . .	43	296	269	38	-	441	-	*35	*30	*17	*25	*30	*33	2
Wayland, . . .	83	899	574	74	-	840	8	83	†-	81	81	83	81	-
Webster, ...	33	248	186	31	-	6	-	33	*1	23	25	30	22	-
Wellesley, . . .	55	288	207	51	-	24	-	55	51	29	47	54	55	-
Wellfleet, . . .	43	107	65	36	-	21	-	43	*4	43	39	42	43	1
Wendell, ...	54	229	100	53	18	185	-	*4	*2	*2	*3	*3	*3	1
Wenham, . . .	53	320	284	49	1	236	1	53	*15	50	50	50	53	-
West Boylston, . .	83	775	526	74	16	593	5	92	91	78	90	84	89	3
West Bridgewater, .	43	808	554	41	12	219	-	†-	†-	†-	†-	†-	†-	†-
West Brookfield, . .	90	1,378	215	77	39	168	17	80	†-	†-	†-	†-	†-	2
West Newbury, . .	134	1,070	625	57	30	385	4	163	150	72	46	40	131	19
West Springfield, . .	128	906	622	118	-	588	1	128	117	124	125	125	128	3
West Stockbridge, .	112	468	306	112	400	321	-	112	*5	112	112	112	112	1
West Tisbury, . .	61	234	121	60	800	131	-	63	35	61	61	60	59	-
Westborough, . .	127	1,773	1,057	114	4	734	-	151	140	117	143	133	144	7

* Incomplete report.

† No report.

Report of Inspection of Animals, Stables, etc. — Concluded.

CITY OR TOWN.	Number Herds inspected.	Number Neat Cattle inspected.	Number Milch Cows inspected.	Number Herds kept Clean and in Good Condition.	Number Sheep inspected.	Number Swine inspected.	Number Goats inspected.	Number Stables inspected.	Number Stables well located.	Number Stables well lighted.	Number Stables well ventilated.	Number Stables kept Clean.	Number Stables with Good Water Supply.	Number Stables improved since Last Report.
Westfield, ...	230	1,570	952	215	32	518	-	229	199	227	228	226	229	-
Westford, . . .	116	1,011	589	100	-	268	-	125	124	113	122	104	124	6
Westhampton, . .	69	706	309	52	-	152	15	88	46	38	61	57	71	2
Westminster, . . .	105	554	362	84	-	-	-	*8	*4	*5	*-	*5	*-	4
Weston, ...	123	1,021	724	113	19	494	1	†-	†-	†-	†-	†-	†-	†-
Westport, . . .	304	1,512	986	274	20	552	2	309	233	179	245	272	285	15
Westwood, . . .	66	501	347	65	-	725	-	*31	*5	*5	*5	*5	*5	1
Weymouth, . . .	158	629	477	*123	3	271	-	*12	*10	*11	*10	*11	*11	1
Whately, ...	109	822	441	107	21	317	-	109	*3	101	109	108	109	1
Whitman, . . .	89	349	275	86	3	227	-	88	*12	79	76	78	88	1
Wilbraham, . . .	113	989	584	105	-	266	4	141	122	116	137	140	135	3
Williamsburg, . .	91	783	367	55	32	154	-	89	*3	*1	*2	*1	*3	-
Williamstown, . .	197	1,754	1,056	170	1,154	797	-	197	†-	119	118	185	194	2
Wilmington, . . .	95	273	*52	94	-	168	-	95	*4	*2	*3	*4	*4	2
Winchendon, . . .	135	694	336	126	62	437	-	188	*14	182	185	130	134	86

Winchester, . . .	22	197	177	13	-	176	-	22	*2	*1	*1	*1	*2	-
Windsor, . . .	88	958	510	86	96	208	-	102	*35	85	79	100	85	-
Winthrop, . . .	16	45	44	16	-	-	-	16	*4	13	14	15	14	1
Woburn, ...	86	327	251	85	6	1,785	-	86	†-	†-	†-	†-	†-	†-
Worcester, . . .	286	2,245	1,713	285	73	2,553	1	286	285	285	285	285	286	2
Worthington, . . .	108	990	430	94	134	199	9	108	96	95	106	97	100	-
Wrentham, . . .	150	646	424	87	-	348	-	150	91	95	93	96	95	-
Yarmouth, . . .	55	182	61	53	23	90	-	*32	*18	*26	*28	*27	*31	1
Totals, . . .	34,106	239,603	145,301	29,380	24,022	93,041	2,634	30,907	14,826	22,568	24,396	25,404	26,834	749

* Incomplete report.

† No report.

No report at all has been received from the inspector of animals in Maynard, and the Leicester inspector may also be said to have made no inspection, as he reports upon 7 herds only, while in 1903 he examined 109 herds.

By referring to the preceding table it will be seen that the returns from many of the cities and towns are incomplete, the inspectors having failed to carry out, as faithfully as they should, the instructions given them. There is no doubt that the letter ordering the inspection was misunderstood by many of the inspectors, as it gave permission to say "the same as last year" in answer to certain questions regarding measurements, where no changes had been made since the last inspection, and a number of them seemed to think that this provision of the order to make the work easier was meant to give them wider latitude than was intended. This accounts for the insufficient returns of inspections of stables from a number of towns where the inspectors are competent, faithful men.

While more herds were examined in 1903, between 3,000 and 4,000 fewer neat cattle are reported and 10,000 fewer milch cows are given.

The number of stables inspected shows a falling off of nearly 4,000. While the returns of the inspectors of animals in 1903 were not as full as in some preceding years, yet in 1904 they are even less satisfactory.

The number of swine reported shows an increase of over 3,000 and the number of sheep a decrease of over 2,000.

An attempt was made to obtain some idea of the number of goats in the State, because of the increasing interest in the breeding of Angora goats; the inspectors' returns show 2,634 of these animals, in comparison with 173 the previous year.

The inspectors of animals are appointed annually in the month of March by the mayor and aldermen in cities and the selectmen in towns, subject to the approval of the Chief of the Cattle Bureau; and the law requires them to be sworn to perform the duties of the position faithfully. While all these inspectors have been approved by him, yet it is impossible for the Chief of the Cattle Bureau to know the qualifications of all the appointees in a State having 353 cities and towns.

In some of the smaller towns the inspectors receive very meagre remuneration, hence it is impossible to obtain the services of men who are willing to give the time and labor to the office that the position requires. It is even alleged that in a few of the small towns the place is given to the lowest bidder. Many of the inspectors are men of ability and faithfulness, and due credit should be given to them for the services they render; unfortunately, there are others who fall far short of the requirements of the work.

The practicability of dividing the State into veterinary districts, and having a veterinarian, appointed by the Chief of the Cattle Bureau, placed in charge of the work in a number of adjacent towns, has been suggested; and this may be brought about if the work done by the inspectors of animals continues to deteriorate, or if those who are negligent do not show more interest or are not supplanted by others who will.

TUBERCULOSIS.

As in previous years, the chief item of expense in the work of the Cattle Bureau is tuberculosis, as the law requires that neat cattle condemned as tuberculous shall be paid for if they have been owned within the Commonwealth for six months, or if the owner has a certificate of tuberculin test approved by the Chief of the Cattle Bureau at the time the cattle were brought into the State; this disease will therefore be considered first, although glanders must not be looked upon as of secondary importance on this account.

As heretofore, the work performed for the purpose of suppressing tuberculosis may be divided under three heads: —

First. — That part of the work comprised under the quarantining of animals by the local inspectors of animals on suspicion of being tuberculous, which must be examined by agents of the Cattle Bureau, and appraised and killed if found to be suffering from the disease, or released if considered free from it.

Second. — Keeping up the quarantine work, to prevent tuberculous cattle being introduced into the dairy and breeding herds of the State. This includes the testing of all cattle over six months old brought from without the State, except beeves for immediate slaughter, by the agent of the

Cattle Bureau at the Brighton stock yards or by agents at other points; and the identification and releasing of cattle upon which tests are required, if accompanied by satisfactory certificates of test, at points outside the stock yards. All cattle brought from without the State to the stock yards at Brighton, Watertown and Somerville, upon which a test is required, are held and tested by the agent of the Cattle Bureau in charge of these stations.

Third. — What is known as "voluntary request work," where entire herds are tested with tuberculin at the request of the owners, with a view to eradicating tuberculosis from them.

The results of the *first section* of the work for suppressing bovine tuberculosis are given below.

During the year animals have been quarantined in 266 different cities and towns of the State by local inspectors as tuberculous, or as having been brought into Massachusetts and held in quarantine until satisfactory evidence of tuberculin test was presented to the Chief of the Cattle Bureau, as follows: —

Massachusetts Cattle.

Number released,	752	
Number condemned, killed and paid for,	1,273	
Number permit to kill, and paid for,	74	
Number permit to kill, no award,	110	
Number died in quarantine, no award,	68	
Number condemned and killed, in process of settlement,	276	
Number released for lack of funds, December, 1903,	4	
Number in quarantine, unsettled,	1	
Total Massachusetts cattle quarantined,		2,558

Cattle from without the State.

Number released,	619	
Number condemned, killed and paid for,	16	
Number condemned and killed, no award,	181	
Number killed at owner's request after first test, no award,	3	
Number died in quarantine,	1	
Number in quarantine, unsettled,	1	
Total, including 290 tested at Brighton,		821
Total number cattle quarantined,		3,379
Total number cattle killed and found to be tuberculous,		1,807

Of the cattle quarantined, 4 were found affected with actinomycosis, 2 of which were condemned and killed, 1 released and 1 killed by owner for beef.

Of the 197 condemned and killed on suspicion of being tuberculous, brought into Massachusetts from without the State, 145 were tested and retested at Brighton, and the other 52 were tested at other places. Sixteen were found to show no lesions of tuberculosis, and the owners received pay therefor from the State. Of these 16, 9 were tested at Brighton and 7 at other points.

During the year 283 cattle, 1 sheep and 4 swine were reported by butchers, renderers and boards of health as having been found tuberculous at time of slaughter. None of these animals were quarantined, and they are not included in the 3,379 above reported.

The *second section* of the work is given below, and includes the testing at Brighton and points outside, and also the granting of permits for bringing cattle from without the State to places outside the quarantine stations at Brighton, Watertown and Somerville.

Receipts of Stock at the Watertown Stock Yards, from Dec. 15, 1903, to Dec. 15, 1904.

Vermont cattle,	5,472
New Hampshire cattle,	3,861
New York cattle,	182
Massachusetts cattle,	2,938
Western cattle,	40,665
Sheep,	40,606
Swine,	6,200
Calves,	22,255

Receipts of Stock at the New England Dressed Meat and Wool Company's Yards at Somerville, from Dec. 15, 1903, to Dec. 15, 1904.

Maine cattle,	842
New Hampshire cattle,	3,707
Vermont cattle,	7,104
Massachusetts cattle,	1,476
Western cattle,	75,530
Sheep,	420,260
Swine,	1,289,310
Calves.	74,571

Cattle not for immediate slaughter have been tested by the agent of the Cattle Bureau at Brighton, and are included in the Brighton report.

Receipts of Stock at Brighton, from Dec. 15, 1903, to Dec. 15, 1904.

Maine cattle,	8,089
New Hampshire cattle,	1,697
New York cattle,	850
Vermont cattle,	1,271
Massachusetts cattle,	15,485
Western cattle,	64,093
Sheep,	57,725
Swine,	12,168
Calves,	41,894
Cattle tested,	12,651
Cattle released after test,	12,506
Cattle condemned after test,	145
Total cattle in stock barn at Brighton,	35,025

The cattle tested at Brighton include those brought to Watertown and Somerville, as well as those unloaded at the Brighton yards. All the milch cows from without the State for the Wednesday market at Brighton arrive Tuesday morning, and are taken to the large stock barn at Brighton and tested with tuberculin by the agent of the Cattle Bureau in charge of the stations, in time to be ready to be sold Wednesday morning; besides the cows, bulls for stock purposes and working oxen are also tested.

The total number of cattle in the stock barn includes the cows, bulls and working oxen brought there from without the State, and also the cattle from various parts of Massachusetts, some of them being milch cows and others cheap beef, as well as cattle sold for beef there on market day brought from adjoining States by the cattle dealers with their cows.

If the milch cows belonging in Massachusetts and offered for sale at the Brighton market could be tested each week, as well as cattle from without the State, it would be a benefit, as only healthy animals could then be bought to go to the milkmen's herds in the eastern part of the Commonwealth to take the places of their discarded stock; but, as reacting cattle would have to be paid for by the State if killed, the present appropriations made for this work would prove insufficient to meet the extra expense entailed.

Any one going to Brighton for cattle now can purchase tested animals, each with a tag in its ear, with the words "tested at Brighton" on one side and a number on the other. This system of numbering makes it possible at any time to trace out a cow from an adjoining State sold at Brighton. If this system could be carried out for all cattle sold at Brighton, it would insure a healthy supply of cows for the milk producer, and also make it possible to learn where the infected herds in remote portions of the State were kept, with a view to cleaning them up in time, and thus still further reducing the amount of bovine tuberculosis in the Commonwealth; but in order to carry out such a plan, more money would be required than is at present available.

The benefit of having the stock sold at Brighton tested is becoming apparent, from the fact that in the towns surrounding Boston, where the milkmen are in the habit of buying their fresh cows at Brighton, very few animals are quarantined as tuberculous; the old, diseased cattle have been killed off, and healthy animals have replaced them. There has not been a cow quarantined as tuberculous in Dedham, Needham, Wellesley or Westwood during the recent annual inspection, and only one each in Norwood and Dover and but a few in Natick, where the farmers buy their fresh cows at Brighton chiefly from among those that have been tested.

A few years ago the Lynn board of health required that all the cows supplying that city with milk should be tested, and that milk could not be sold there from any that reacted; a number were killed, and new purchases have been largely made from tested cows bought at Brighton or coming from outside the State. The results are apparent, when it is noted that very few animals in that section are quarantined as tuberculous.

On the other hand, there are localities where the farmers trade around among themselves, or smuggle cows across the line from southern New Hampshire without the test, that are veritable hotbeds of the disease. A few years ago a large number of herds were tested in Billerica and Dracut by veterinarians employed by the farmers, who had the work done not with a view of eradicating tuberculosis, but simply as a matter of speculation in selling tuberculous cows to the State of Massachusetts. Little pains was taken with disinfection and little care exercised in buying new cows, with the result that these and adjoining towns are still full of tuberculous cattle, and many are condemned each year in them. The law has since been changed, so that private tests are not now recognized by the State authority. If every farmer would take pains to disinfect his stable every time the State kills a tuberculous cow for him, and then buy only tested cows to replace those killed, still greater advances in suppressing this bovine scourge would be made. The difficulty seems to be in securing the intelligent coöperation of the cattle owners in this work.

In addition to the cattle tested at Brighton, the following statement shows the number of permits granted for bringing cattle to other points, the number of cattle tested after arrival and the number supposed to have been tested before shipment: —

Report of Cattle brought into the State during the Year, to Points outside of the Quarantine Stations.

During the year 1904 the following cattle were brought into the State to points outside of the quarantine stations: —

For dairy and breeding purposes, tested before shipment,	3,185
For dairy and breeding purposes, tested after arrival,	3,663
	6,848
Neat cattle on which no test was required,	7,062
Total,	13,910

Nearly all of these were brought in on permits issued by the Chief of the Cattle Bureau, only 352 head having been brought in without permits, which were reported to this Bureau by railroad agents, local inspectors or others. Of these, 58 were accompanied by satisfactory certificates of tuberculin test, 68 were slaughtered at once for beef, 5 were calves under six months old, and the remainder, 221, were tested by agents of the Cattle Bureau.

There were 830 permits issued, 106 of which were not used; on the balance, 13,558 cattle were brought into the State.

Permits were also issued allowing 8 herds of cattle to be brought into the State for exhibition at agricultural fairs, to remain a short time. Permits were issued to one dealer allowing cattle to be brought weekly from Rhode Island into this State, after having been previously tested at Brighton and shipped thence to Providence, R. I.; these are not included in the above figures.

The cattle and calves on which no test was required were as follows: —

Returned from out-of-State pastures,		940
To be pastured in the State during the season only,		40
To be pastured till fall and then slaughtered,		28
Allowed to be returned to State from which they were shipped, shortly after arrival,		3
Previously tested in Massachusetts inside of six months,		1
Died before test could be made,		1
Unloaded en route through State,		68
Brought into State to be photographed, remaining one day only,		5
Oxen allowed to be used in State on farm bordering the line,		2
Calves under six months old,		99
Cattle for immediate slaughter,	2,330	
Calves for immediate slaughter,	3,545	
		5,875
Total,		7,062

It will be seen above that 3,663 cattle were tested after arrival by agents of the Cattle Bureau, and that 3,185 were accompanied by certificates of test; all the former were honestly tested, and probably many of the latter. At present the list of veterinarians in Maine, New Hampshire and Vermont is thought to include only honest men; but some of the cattle brought from New York State, it is feared, have not been honestly tested, as, owing to the greater distance from Massachusetts of many of these veterinarians, and the difficulty of obtaining reliable information concerning them, it is believed that some may have yielded to pecuniary temptation, and done dishonest work for unscrupulous dealers.

The tuberculin test is at present believed in by many persons, and a large number of cattle owners do not care to buy an animal that will not pass it; therefore a breeder who sells an animal with a fraudulent certificate of test as one that has passed it, or who sells as sound with a fraudulent certificate of test an animal that would not pass it, is obtaining money under false pretences, and is no better than a swindler.

If a breeder thinks tuberculin is a humbug, or honestly thinks it injures an animal, he should frankly state it, and refuse to have an animal in his herd tested for a prospective buyer, but tell the would-be purchaser to buy it as it stands, and do what he pleases with it after he has paid for it; but to sell an animal as tested to a purchaser who sincerely believes in the test, giving a fraudulent certificate of test with it, even if he knows he has not a case of tuberculosis in his herd, is an unscrupulous piece of rascality on the part of both the seller and the so-called veterinarian furnishing the proof of the alleged test.

At a meeting of the Interstate Association of Live Stock Sanitary Boards, at St. Louis, Mo., last August, the secretary read a paper by the Chief of the Cattle Bureau of the Massachusetts State Board of Agriculture upon the "Prevention, suppression and control of certain communicable diseases of domestic animals," in which he advocated that the United States Bureau of Animal Industry test with tuberculin all cattle over six months old intended for any other purpose than immediate slaughter, which are to be exported from one State to another, allowing only those that pass the test to proceed to their destination. If this could be brought about, it would save money to the States which now require cattle to pass a tuberculin test before being allowed to go free, — money which could well be expended for other purposes; and would also insure the work being honestly and correctly performed in all instances.

The United States government now holds at quarantine stations all cattle imported into the country, and tests all except those from the islands of Jersey and Guernsey, where tuberculosis is unknown. The United States Department of Agriculture now has regulations to protect the northern States from the introduction of Texas fever from districts in the south, where it prevails; it seems perfectly proper, therefore, that it should protect one State against the introduction of bovine tuberculosis from an adjoining State. If this could be brought about, much dishonesty, annoyance and expense to States requiring a tuberculin test upon cattle brought into them would be abolished.

If healthy cattle to be sold into herds where tuberculosis exists could only be immunized in some way, so that after being tested they would remain free of the disease, it would be of the greatest value, and save the State from paying for many cows that it now remunerates owners for after being owned in this Commonwealth two or three years. This question is now exciting much interest in Europe and this country, and it is hoped that in time some practical method of conferring upon animals immunity from bovine tuberculosis may be discovered.

The *third section* of the work for the suppression of tuberculosis among cattle consists in testing entire herds for owners who wish to eradicate the disease from their stables, and are willing to thoroughly disinfect their premises and agree to buy only tested animals in the future. Owing to the expense of this work, none has been undertaken except for owners who were willing to bear part of the burden. Cattle have been tested free of expense to the owner, with the understanding that all reacting animals were to be killed, and that the State would pay for the badly diseased only, he agreeing to take what the butcher would allow him for those that passed a slaughter-house inspection as fit for beef. Even under these onerous conditions, a number of herds have been tested; and towards the end of the year the requests of two or three owners to have their herds tested were refused, because of insufficient funds for such work. Undoubtedly more could be done in this direction if more money was available for the purpose.

Below is given the number of herds and cattle tested at the request of their owners, with the results: —

Number of herds tested,		20
Number of animals tested,		359
Number condemned and rendered,	43	
Number condemned and passed for beef, no award,	59	
Number condemned and found free from tuberculosis, for which the State has paid,	3	
Number that did not react,	254	
		359

In 7 of these herds no diseased animals were found; an animal reacted in one of them, but when killed no lesions were found; this cow was on a farm where a number of diseased animals were killed in 1903, the herd being tested this year to see if the work was complete. Six of the herds had been tested in previous years, and were tested again with a view to completing their cleaning up; two of these were given tests in the spring and fall; on these farms tuberculosis has been either eradicated or nearly so, the number of reacting animals being very few. The other 14 were new herds, and the percentage of reactions varied from 0 to over 90 per cent.

It is encouraging to find that in herds tested the previous year the disease has been either entirely or nearly eradicated.

GLANDERS.

During the year ending Dec. 15, 1904, there have been fewer cases of glanders and farcy among horses in Massachusetts than during the year ending Dec. 15, 1903, as far as can be ascertained through the various available sources of information.

For the year ending Dec. 15, 1903, 860 horses were killed or died because of this disease; while up to the corresponding date in 1904 the number was 809, showing a decrease of 51. While this improvement is encouraging, yet the conditions must still be looked upon as serious.

The total number of animals examined during the past year because of glanders is 1,371, — a larger number than in any previous year; but this large number is partly made up of horses in stables where all the animals have been tested with mallein. In the tables given below only the horses that have been killed or that have died, or else have been reported by the local inspectors, veterinarians and renderers, are included in the first table, while in the second table the work done with mallein is given separately.

The work done with mallein has entailed an immense amount of labor upon the agents of the Cattle Bureau, as it has been necessary to keep track of all reacting animals, and retest them at intervals of a month until they ceased to react or showed physical symptoms of the disease and were killed. In some instances animals have been tested five or six times before a final disposition of them could be made.

The following table gives the number of cases or suspected cases of glanders or farcy that have occurred in 1904, in comparison with 1903. The report for the latter year includes everything, while in the report for 1904 the mallein tests are given in a separate table.

CITY OR TOWN.	1903.		1904.		Increase.	Decrease.
	Killed or died.	Negative.	Killed or died.	Negative.		
Acton, . . .	2	1	4	1	2	–
Acushnet, . .	1	–	–	–	–	1
Adams, . . .	–	–	4	1	4	–
Amesbury, . .	–	1	1	–	1	–
Amherst, . .	4	–	–	–	–	4
Arlington, . .	8	7	7	3	–	1
Ashburnham, . .	–	–	–	1	–	–
Ashby, . . .	1	–	–	–	–	1
Ashfield, . .	1	–	–	1	–	1
Ashland, . .	1	–	1	–	–	–
Attleborough, .	2	2	–	–	–	2

CITY OR TOWN.	1903.		1904.		Increase.	Decrease.
	Killed or died.	Negative.	Killed or died.	Negative.		
Athol, . . .	–	–	2	1	2	–
Auburn, . . .	3	–	1	–	–	2
Avon, . . .	–	–	1	–	1	–
Barnstable, . .	–	1	–	2	–	–
Barre, . . .	1	–	–	–	–	1
Bedford, . .	1	3	–	–	–	1
Belchertown, . .	–	–	1	1	1	–
Belmont, . .	1	–	2	–	1	–
Berlin, . . .	1	–	–	–	–	1
Beverly, . . .	3	21	3	–	–	–
Billerica, . .	2	1	–	1	–	2
Bolton, . . .	1	–	–	–	–	1
Boston, . . .	250	2	254	23	4	–
Boxborough, . .	–	–	–	2	–	–
Boylston, . .	1	–	–	2	–	1
Braintree, . .	2	–	3	1	1	–
Brockton, . .	9	4	4	6	–	5
Brookline, . .	6	–	3	1	–	3
Burlington, . .	3	–	–	–	–	3
Cambridge, . .	91	12	86	12	–	5
Charlton, . .	1	–	3	–	2	–
Chelmsford, . .	1	–	–	3	–	1
Chelsea, . . .	24	2	16	4	–	8
Chesterfield, . .	–	1	–	1	–	–
Chilmark, . .	1	–	–	–	–	1

CITY OR TOWN.	1903.		1904.		Increase.	Decrease.
	Killed or died.	Negative.	Killed or died.	Negative.		
Clinton, . . .	1	–	2	1	1	–
Colrain, . . .	–	–	–	1	–	–
Concord, . .	–	–	6	1	6	–
Dalton, . . .	1	–	–	–	–	1
Danvers, . .	–	–	4	1	4	–
Dartmouth, . .	–	–	1	1	1	–
Dedham, . .	8	–	7	1	–	1
Deerfield, . .	–	–	–	1	–	–
Dighton, . .	1	–	–	–	–	1
Dover, . . .	1	–	–	–	–	1
Dracut, . . .	2	–	1	1	–	1
Dudley, . . .	1	–	–	–	–	1
East Bridgewater, .	2	–	–	1	–	2
Essex, . . .	–	–	2	–	2	–
Everett, . . .	9	44	6	2	–	3
Fairhaven, . .	1	–	–	–	–	1
Fall River, . .	30	5	37	7	7	–
Fitchburg, . .	5	1	1	1	–	4
Foxborough, . .	–	1	1	1	1	–
Framingham, . .	6	–	2	–	–	4
Franklin, . .	–	–	–	1	–	–
Freetown, . .	–	1	1	–	1	–
Gardner, . .	2	1	1	1	–	1
Gloucester, . .	1	2	1	1	–	–
Grafton, . . .	3	1	2	–	–	1

CITY OR TOWN.	1903.		1904.		Increase.	Decrease.
	Killed or died.	Negative.	Killed or died.	Negative.		
Greenfield, . .	–	–	3	–	3	–
Greenwich, . .	–	1	–	2	–	–
Groveland, . .	–	–	–	1	–	–
Hamilton, . .	3	7	–	–	–	3
Hardwick, . .	1	2	–	–	–	1
Harvard, . .	–	1	1	–	1	–
Harwich, . .	2	–	–	–	–	2
Haverhill, . .	2	–	3	–	1	–
Hingham, . .	–	–	–	1	–	–
Holden, . . .	2	–	1	–	–	1
Holliston, . .	4	–	1	–	–	3
Hubbardston, . .	–	2	–	1	–	–
Hyde Park, . .	1	1	3	–	2	–
Ipswich, . .	1	–	–	1	–	1
Kingston, . .	–	–	3	–	3	–
Lawrence, . .	19	3	14	15	–	5
Leicester, . .	2	–	–	–	–	2
Leominster, . .	–	3	–	2	–	–
Lexington, . .	7	3	8	1	1	–
Lincoln, . . .	2	1	5	4	3	–
Lowell, . . .	20	6	23	2	3	–
Lynn, . . .	17	2	10	2	–	7
Malden, . . .	6	–	6	3	–	–
Marblehead, . .	1	–	1	1	–	–
Marlborough, .	1	–	1	–	–	–

CITY OR TOWN.	1903.		1904.		Increase.	Decrease.
	Killed or died.	Negative.	Killed or died.	Negative.		
Marshfield, . .	–	–	1	–	1	–
Maynard, . .	–	–	1	1	1	–
Medfield, . .	1	1	2	–	1	–
Medford, . .	6	2	3	–	–	3
Medway, . .	–	–	1	–	1	–
Melrose, . .	2	–	1	1	–	1
Methuen, . .	1	1	3	1	2	–
Middleborough, .	–	–	–	1	–	–
Milford, . . .	2	1	–	–	–	2
Millbury, . .	1	–	–	–	–	1
Milton, . . .	3	6	3	–	–	–
Nahant, . . .	1	–	2	–	1	–
Natick, . . .	–	–	3	1	3	–
Needham, . .	–	–	4	–	4	–
New Bedford, .	6	3	1	2	–	5
Newbury, . .	–	1	1	–	1	–
Newburyport, .	6	–	3	–	–	3
Newton, . .	15	43	8	6	–	7
North Adams, .	4	–	1	1	–	3
North Andover, .	6	–	4	–	–	2
North Attleborough,	–	–	–	1	–	–
Northampton, .	–	1	1	1	1	–
Northborough, .	2	–	1	–	–	1
Northbridge, . .	1	1	–	1	–	1
Northfield, . .	–	–	–	2	–	–

CITY OR TOWN.	1903.		1904.		Increase.	Decrease.
	Killed or died.	Negative.	Killed or died.	Negative.		
Norton, . . .	–	–	–	1	–	–
Norwood, . .	1	1	1	–	–	–
Orange, . . .	–	–	–	3	–	–
Orleans, . .	–	–	–	1	–	–
Oxford, . . .	1	–	1	–	–	–
Paxton, . . .	1	–	1	1	–	–
Peabody, . .	4	–	–	–	–	4
Pembroke, . .	1	2	–	1	–	1
Pepperell, . .	–	2	5	–	5	–
Pittsfield, . .	–	1	1	1	1	–
Princeton, . .	1	–	2	2	1	–
Quincy, . . .	17	8	5	1	–	12
Randolph, . .	–	–	5	4	5	–
Reading, . .	3	–	–	–	–	3
Revere, . . .	3	1	2	2	–	1
Rowley, . .	–	–	–	1	–	–
Rutland, . .	–	–	1	–	1	–
Salem, . . .	–	2	4	1	4	–
Saugus, . . .	–	3	–	4	–	–
Scituate, . .	–	–	1	–	1	–
Sharon, . . .	–	1	1	1	1	–
Sheffield, . .	1	–	–	–	–	1
Sherborn, . .	–	1	1	–	1	–
Shrewsbury, . .	1	–	–	–	–	1
Somerset, . .	1	–	–	–	–	1

CITY OR TOWN.	1903.		1904.		Increase.	Decrease.
	Killed or died.	Negative.	Killed or died.	Negative.		
Somerville, . .	52	3	61	11	9	–
Southborough, .	2	1	–	–	–	2
Southbridge, . .	2	–	1	–	–	1
Spencer, . .	–	–	1	–	1	–
Springfield, . .	–	1	–	1	–	–
Stoneham, . .	3	1	1	–	–	2
Stoughton, . .	1	–	–	1	–	1
Stow, . . .	–	–	1	1	1	–
Sudbury, . .	2	–	1	4	–	1
Sutton, . . .	–	1	–	2	–	–
Swampscott, . .	1	–	–	–	–	1
Swansea, . .	–	1	1	–	1	–
Taunton, . .	1	–	3	–	2	–
Tewksbury, . .	1	1	–	2	–	1
Topsfield, . .	–	–	–	1	–	–
Townsend, . .	1	1	–	–	–	1
Uxbridge, . .	–	–	1	–	1	–
Wakefield, . .	2	2	4	–	2	–
Walpole, . .	1	–	1	1	–	–
Waltham, . .	7	3	1	1	–	6
Warwick, . .	1	1	–	–	–	1
Watertown, . .	3	–	7	3	4	–
Wayland, . .	–	1	2	–	2	–
Wellesley, . .	1	5	–	–	–	1
West Bridgewater, .	1	–	–	1	–	1

CITY OR TOWN.	1903.		1904.		Increase.	Decrease.
	Killed or died.	Negative.	Killed or died.	Negative.		
West Springfield, .	–	–	–	1	–	–
West Tisbury, .	2	–	–	–	–	2
Westborough, .	1	–	–	–	–	1
Westfield, . .	–	–	–	1	–	–
Westford, . .	–	–	2	–	2	–
Westhampton, .	2	4	–	–	–	2
Westminster, . .	2	3	4	2	2	–
Weston, . . .	5	2	2	–	–	3
Westport, . .	1	1	–	–	–	1
Westwood, . .	7	–	4	1	–	3
Weymouth, . .	6	1	1	4	–	5
Whitman, . . .	3	1	–	–	–	3
Wilmington, . .	–	1	–	1	–	–
Winchester, . .	1	–	2	2	1	–
Winthrop, . .	–	–	1	–	1	–
Woburn, . .	1	1	1	1	–	–
Worcester, . .	67	9	77	3	10	–
Worthington, . .	–	–	–	3	–	–
Wrentham, . .	1	–	–	–	–	1
Totals, . .	860	273	809	217	–	–

It will be seen by the above table that actual cases of glanders or farcy have occurred during the past year in 105 cities and towns in this Commonwealth, to say nothing of towns where suspected animals were reported which proved not to be diseased. In 1903 actual cases occurred in 117 cities and towns, showing a decrease of 12.

In cities and towns where glanders occurred in both 1903 and 1904 it will be seen that there was an increase in 22 cities and towns outside of Boston and a decrease in 34, while it remained stationary in 12. Including Boston, it occurred both years in 69 cities and towns.

There are 48 towns in which cases occurred in 1903 where none were reported in 1904, and 36 towns in which cases occurred in 1904 where none were found in 1903, — a decrease of 12.

This table does not give the towns where suspected cases were reported in 1903, which upon examination proved not to be cases of contagious disease; if it did, the negative column would foot up 290, instead of 273.

The number of cases occurring in Boston are given by courtesy of the veterinarian of the Boston board of health. Most of the negative cases in Boston were reported by one of the renderers, but the veterinarian of the board of health had investigated them, and was of the opinion that they were not glanders. He also reported a number of cases that were not on the renderer's report. It seems only fair, as well as more accurate, this year to be governed entirely by the information obtained from him, rather than to combine his reports with those of the renderers, as has been done in past years.

The accompanying table shows the amount of work done with mallein during the year, where entire stables of horses were tested upon premises where cases of glanders occurred, giving the towns, number of stables and results. This work has been undertaken to rid stables of this disease, to protect other horse owners and to prevent animals from becoming infected that have been exposed, as well as aborting its development in horses already infected through the therapeutic effect of mallein.

Stable Tests with Mallein.

CITIES AND TOWNS.	Number of Stables.	Number of Horses tested.	Released on First Test.	Released on Subsequent Test.	Killed, with Clinical Evidence of Glanders.	Under Observation.
Acton,	2	16	14	2	–	–
Cambridge,	4	179	120*	46	7	6
Clinton,	1	2	–	–	–	2
Concord,	1	30	23	4	3	–
Dedham,	1	8	6	2	–	–
Lexington,	1	4	4	–	–	–
Lincoln,	1	5	5	–	–	–
Maynard,	1	6	5	1	–	–
North Andover,	1	4	4	–	–	–
Pepperell,	1	6	–	2	2	2
Randolph,	1	9	6	3	–	–
Somerville,	1	27	18	9	–	–
Watertown,	2	39	23	16	–	–
Westminster,	1	9	–	5	4	–
Westford,	1	3	2	–	1	–
Westwood,	1	15	14	1	–	–
Totals,	21	362	244	91	17	10

* Three horses negative on first test, but showed physical symptoms of glanders six to eight months later, and were killed.

It will be seen by the above tables that 1,086 animals were reported as having glanders or farcy, of which there were: —

Killed or died,		809
Released,		217
		1,026
In addition, there were tested with mallein,	362	
Less number killed (given in first table),	17	
		345
Total number on books,		1,371

All the cases have been disposed of except 10, which reacted to mallein at the time of the last test, and will have to be carried forward on the books of 1905 until they cease to react or show physical symptoms of glanders and are killed.

During the past two or three years the work of testing with mallein has been carried on with the consent and co-operation of owners; but in order to give the Chief of the Cattle Bureau more authority in instances where owners were too shortsighted to appreciate the value of this work, as well as in stables where horses are boarded, and also to provide for a better condition of blacksmith shops and public watering troughs, the following order was issued: —

CATTLE BUREAU ORDER, NO. 12.

COMMONWEALTH OF MASSACHUSETTS,
CATTLE BUREAU OF THE STATE BOARD OF AGRICULTURE,
STATE HOUSE, BOSTON, June 20, 1904.

To All Persons whom it may concern.

By virtue of the power and authority vested by law in the Cattle Bureau of the State Board of Agriculture, under the provisions of chapter 90 of the Revised Laws and chapter 116 of the Acts of 1902, you are hereby notified that glanders or farcy, which is a contagious disease, and is so recognized under the laws of this Commonwealth, prevails extensively among horses and mules in some sections of this State.

You are hereby further notified that, in order to prevent its spread, this Bureau has issued the following order: —

1. In stables or upon premises where horses or mules are kept in this Commonwealth (except Boston) in which cases of glanders or farcy occur, any or all of the animals kept in such stables or upon such premises will be tested with mallein in such instances as the Chief of the Cattle Bureau deems it necessary to do so. Animals reacting to the mallein test will be held in quarantine, and the owners are forbidden to sell or dispose of such animals until they are released from quarantine by order of the Chief of the Cattle Bureau; but he will give permission to use animals which do not show physical symptoms of glanders or farcy. Animals which develop physical signs of glanders or farcy will be killed; animals ceasing to react will be released as soon as the public safety will permit.

2. When an animal with glanders or farcy has died, or is killed by order of the Chief of the Cattle Bureau or with the consent of the owner (outside of the city of Boston), no other

horse or mule shall be put in any stall, shed or inclosure formerly occupied by an animal so diseased, until such stall, shed or inclosure has been thoroughly disinfected in accordance with the rules and regulations of the Cattle Bureau.

3. In stables where the Chief of the Cattle Bureau tests all the animals kept therein, no horses or mules shall be introduced into or sold from the stable without his sanction, until he declares the premises free from infection.

4. Blacksmiths, when directed to do so, must disinfect their shops in accordance with the instructions of the Chief of the Cattle Bureau or his authorized agent.

5. In instances where the circumstances require it, the proper authorities are hereby ordered to close the public watering troughs when directed to do so by the Chief of the Cattle Bureau, the same to remain closed until he gives permission to reopen them. Public watering troughs in cities or towns (outside of Boston) where cases of glanders occur are to be cleansed at least once a week during the summer months.

Inspectors of animals in towns where glanders or farcy occurs shall publish this order by posting a printed copy thereof in three or more public places within the limits of their respective cities or towns.

This order shall take effect upon its approval.

AUSTIN PETERS,
Chief of Cattle Bureau.

COUNCIL CHAMBER, STATE HOUSE.

Approved in Council, June 22, 1904.

EDWARD F. HAMLIN,
Executive Secretary.

The system of employing a man with a horse and wagon to go to stables in the vicinity of Boston where cases of glanders have occurred, and see that they are properly disinfected, has been continued during the year, it is hoped with good results. For the year ending Dec. 15, 1904, 266 stables have been visited, at most of which the disinfecting was performed or completed by the agent of the Cattle Bureau. He has also whitewashed 66 blacksmith shops where glandered horses had been recently shod. He also reported, at the office, watering troughs in 8 cities and towns where they were unclean. In such cases a copy of Order No. 12 has been sent to the proper authorities, with directions to immediately cleanse the troughs reported and to see that they are kept clean in the future. A copy of Order No. 12, with section 5 underscored, has also been sent to the authority having charge of the public watering troughs in each city and town where cases of glanders have occurred; also the necessary copies to inspectors of animals, to post as required by the order.

In Worcester also a number of stables have been disinfected at the expense of the State where glandered horses have been killed, in instances where the owners were too ignorant or too careless to do it properly. In the better class of stables the proprietor comprehends the necessity and importance of doing this work thoroughly, and also has sufficient intelligence to carry out the directions given him.

The reports of renderers, as required by section 111, chapter 75 of the Revised Laws, continue to be of great value, as the returns of many cases received at these establishments are frequently the first reports, and often the only ones, received by the Cattle Bureau. When a case is reported as occurring outside of the limits of the city of Boston, which has not previously been given, the inspector of animals for the town from which the horse came, or an agent of the Cattle Bureau, is immediately sent to examine any other horses kept upon the premises, and it is also seen that the disinfection of the stable is properly attended to. These measures are undoubtedly of great assistance in checking the spread of this malady.

A comparative table is herewith given of the renderers' reports of 1903 and 1904. It is encouraging, in that it seems to show a slight improvement in the conditions for the past year over the preceding one.

Comparative Table. — Reports of Rendering Companies, 1903 and 1904.

RENDERING COMPANIES.	NUMBER OF REPORTS.		NUMBER OF CASES.		NUMBER IN BOSTON.		NUMBER OUT OF BOSTON.		NUMBER OUTSIDE OF BOSTON NOT PREVIOUSLY REPORTED.			
	1903.	1904.	1903.	1904.	1903.	1904.	1903.	1904.	1903.	1904.	Increase.	Decrease.
Guy U. Barnes Rendering Company, Fall River,	18	30*	27	28*	-	-	27	28	5	3	-	2
J. J. Burke, South Sherborn,	4	8	7	6	-	-	7	6	-	1	1	-
C. S. Bard, Haverhill,	1	3	1	3†	-	-	1	2	-	2	2	-
Fitchburg Rendering Company,	4	6	6	5	-	-	6	5	1	-	-	1
William Higgins, Malden,	4	2	4	2	-	-	4	2	3	2	-	1
Lowell Rendering Company,	3	14	5	6	-	-	5	6	-	2	2	-
W. C. Lawrence, Brockton,	9	4	12	2	-	-	12	2	3	1	-	2
Jas. E. McGovern, Lawrence,	14	7	24	17	-	-	24	17	2	1	-	1
Muller Bros., North Cambridge,	35	29	95	78	3	1	92	77	14	11	-	3
McQuade Bros., Auburn,	3	-	5	-	-	-	5	-	-	-	-	-
New England Rendering Company, Brighton,	51	46	133	139	22	34	111	105	47	35	-	12
New Bedford Product Company,	1	1	7	2	-	-	7	2	-	-	-	-
Parmenter & Polsey Fertilizer Company, Peabody,	21	24	28	18	-	-	28	18	3	8	5	-
A. K. Silloway, Newburyport,	3	2	5	2	-	-	5	2	2	1	-	1
James P. Trainor, Auburn,	3	-	3	-	-	-	3	-	1	-	-	1
N. Ward Company, Boston,	46	51	219	215	170	186	49	29	11	7	-	4
Whitman & Pratt Rendering Company, Lowell,	4	15	6	10†	-	-	6	9	2	1	-	1
Worcester Rendering Company, Auburn,	26	36	57	78	-	-	57	78	15	26	11	-
Totals,	250	278	644	611	195	221	449	388	109	101	21	29
Total decrease in cases not previously reported,	-	-	-	-	-	-	-	-	-	-	-	8

* Where the total number of the renderers' reports exceeds the number of cases of glanders reported, it is because some of them gave reports of cases of tuberculosis among cattle.

† One of the animals received at the rendering works came from New Hampshire.

Two horses were killed which the Commonwealth had to pay for, — 1 in Fall River and 1 in Lawrence.

The horse in Fall River was condemned as having farcy, and reacted when tested with mallein; but upon autopsy no internal lesions of glanders could be found, and it was necessary to settle with the owner. As it was quite a good animal, it cost $200 to settle the case.

The horse in Lawrence was killed in January, 1904. It was previously owned by the Lowell fire department, and was first reported as a case of glanders in the autumn of 1903. Repeated guinea pig tests were negative, and the animal was released from quarantine. Later it was bought by a stable keeper in Lawrence, and was quarantined by the inspector of animals in that city. Guinea pigs inoculated from the discharge from its nose failed to develop glanders, and the horse when tested with mallein failed to react to the test; but the inspector of animals of Lawrence was positive the animal had glanders, and if it had been released it would have caused a great deal of criticism, having also been once quarantined and released in Lowell. It would have been traded around if released in Lawrence, and would have been again suspected of having glanders and quarantined somewhere else. For these reasons it seemed good public policy to have it killed, even if the Chief of the Cattle Bureau and his agents believed the animal to be free from glanders. The owner agreed to accept $100 as the value of the horse if it proved to be free from glanders. Upon post-mortem examination no lesions of glanders could be found; the animal was simply suffering from pus in the left frontal sinus. Two small nodules were found in the lungs, but upon microscopic examination these were found to be due to a small worm encysted in the lung tissue. The owner was, therefore, paid for the horse.

Two cases of malignant tumors have been reported during the year as glanders or farcy. One of these was quarantined in Cambridge on suspicion of having farcy. It was decided to be not a case of this disease; but, as it was evident the animal must succumb before long to the trouble, the owner was requested to notify the Cattle Bureau's agent when it died. Two or three weeks after it was released from quarantine, word was received that it had died; and an autopsy was held upon the remains at the New England Rendering Company's works at Brighton, revealing a diseased condition of the lymphatic glands in the head, neck, and thoracic and abdominal cavities, of a nature resembling lympho-sarcoma. The other animal was reported to Dr. H. P. Rogers, an agent of the Cattle Bureau, by the New England Rendering Company, as a suspected case, which had been removed from a stable where a horse had been killed as having farcy a few months previously. A post-mortem examination by Dr. Rogers revealed numerous small tumors in the lungs, liver and spleen. Specimens from the lungs examined microscopically proved to be sarcomata, — a form of tumor more malignant than cancer.

The guinea pig test has been used as extensively for determining doubtful cases of glanders and farcy as in previous years, with the usual satisfactory results. This work has been done by Dr. Langdon Frothingham at the Harvard Medical School, who has also done the other pathological work for the Cattle Bureau. Much of the work in connection with glanders has been done by Dr. Howard P. Rogers, assisted, when there was more than he could do, by Dr. W. T. White. Both have shown great interest in their duties and have been indefatigable in their labors.

As in 1903, it is again a sad duty to record three human deaths from glanders, — one in Chelsea, one in Fall River and one in Boston.

In many of the instances where glanders is reported as occurring in isolated cases or as small outbreaks in towns in 1904, where no cases occurred in 1903, it has been found that diseased animals have been taken there that were bought from a certain class of dealers in cheap horses in Boston. On the other hand, quite a number of horses are killed in Boston each year at auction rooms and sales stables, which have been brought there from adjoining cities and towns to be sold, reported to the veterinarian of the Boston board of health as glandered, and are by him ordered killed.

The outbreak in Kingston is traceable to a pair of cheap horses bought from one of these unscrupulous dealers in Boston, and one case each in Northborough, Haverhill, Cambridge, Framingham and Brockton are traceable to like sources. Two horses were killed in Athol early in December, which were bought in Boston the last of October. While dealers in the cheap class of horses do not sell glandered horses exclusively, — in fact, only occasionally having horses with glanders, — at the same time, these men are not above selling such animals when they come into their hands, if they are not discovered and reported to the Boston board of health.

The small outbreak in Greenfield was caused by a horse which was brought there from an adjoining town, and very likely originally came from the neighborhood of Boston or Worcester; but he had been traded through so many different hands that it was impossible to ascertain where he originally came from.

The case in Uxbridge was taken there from Worcester, and was traded about in that town. With the assistance of the State police, one of the Uxbridge men was prosecuted; but, as usual, it was not possible to prove that he knew the horse had glanders when he disposed of it, so he was acquitted.

It is well-nigh impossible to secure a conviction in these cases, as the law requires proof that the seller knew or had reasonable cause to believe that an animal was suffering from a contagious disease at the time of sale. In the rare cases where a conviction is secured, the courts do not look upon the offence as being very serious, and the culprit usually escapes with a fine of from $25 to $50.

That some of the dealers in the cheap class of horses have reason to know what glanders is, is shown by the fact that cases are reported as having been killed at some of the stables, by the renderers or by the Boston board of health, from which horses with glanders have been sold to people in country towns. It is certain that some of the animals at the time of sale were suffering from the disease in such an advanced form that any one who had ever had experience with it ought to have known it. All the facts in regard to the cases reported from outside towns of horses bought from Boston dealers have been reported in full to the veterinarian of the Boston board of health. He has also reported to the Cattle Bureau any horses brought to sales stables in Boston and adjoining towns which have been killed as having glanders; thus giving the Chief of the Cattle Bureau an opportunity to send an agent, or the inspector of animals in the town where the case occurred, to examine all other horses on the infected premises and ascertain whether there were any more cases of the disease there or not, and to see that proper steps were taken to disinfect the place where the diseased animal had been kept.

No one has any sympathy for a man who wants to get something for nothing, and when such a person is cheated it serves him right, if he is the only sufferer; but when he is sold animals that are a source of danger to the horses of his neighbors, and a menace to human life, it is time a stop was put to this nefarious business, and better legislation and stricter laws become necessary.

Occasionally a dealer of good standing sells a second-hand horse to a farmer or country merchant, which in the course of three or four months may develop glanders, and which was very likely infected at the time it was purchased, although showing no symptoms of disease at the time of sale. Such animals are sold innocently by the dealer, and it is the purchaser's misfortune, if, after using such an animal a while, it develops symptoms of the disease, or if any other horses belonging to him have to be condemned.

On the other hand, unscrupulous dealers sometimes sell horses which show manifest symptoms of glanders or farcy at the time of sale, taking advantage of the unfamiliarity of the purchaser with diseases of this character. That selling these cheap horses is a profitable business, is manifest by the amount of advertising in Boston papers of second-hand horses for sale, representing old, balky and vicious horses as being very desirable animals.

Farmers and merchants are cautioned against purchasing animals from dealers of this character. There are plenty of respectable and reputable horse dealers; and farmers and other persons in country towns are advised that it is better to purchase an animal for what it is, at a fair price, rather than to search for bargains in bogus club stables and fake sale stables, or from unknown ice companies, coal companies going out of business, and unheard-of express companies that never existed except in the imaginations of the advertisers. The old "widow-lady" advertisement is played out, and the lady whose husband has recently died does not nowadays advertise a pet horse for sale as frequently as she did a few years ago; but the "widows" are just as numerous and active as ever, under other guises, and the profitableness of their business can be judged by the extent of their advertising. This portion of the report can well be closed with the advice of the elder Mr. Weller to his son Samuel, "Be werry careful o' widders."

CONTAGIOUS DISEASES OF SWINE.

During the year 1904 there were fewer outbreaks of contagious diseases among swine than during the preceding year, and, as many cases reported were in smaller piggeries, fewer animals were involved. The cases reported were also more varied than usual; those reported as hog cholera were of the hog cholera type, but there seems to have been little if any true hog cholera. Most of the outbreaks quarantined as hog cholera chiefly resembled swine plague, being generally a septic pneumonia with diarrhœa, resulting from feeding city swill which had undergone putrefactive changes, or some form of poisoning due to material contained in the swill. Some of the powders and soaps used for washing dishes in hotels and similar large establishments sometimes produce symptoms resembling swine plague. Where the cause of sickness was traceable to city swill, a change of food seems to have been sufficient, and most of the pigs have recovered after this was done. More swine have been quarantined for tuberculosis than usual; and in two instances where swine have been supposed to have some form of hog cholera the principal trouble seems to have been something else.

In one instance, in Quincy, an autopsy on a pig that died showed it to have been suffering from tuberculosis, and it is probable that the others which died on this farm also had this disease. Another outbreak, reported in Dracut, where the pigs had some lung trouble, appears to have been due quite as much to thread worms (*strongylus paradoxus*) in the lungs as to swine plague, although the swine plague organism was found by Dr. Frothingham in a specimen of lung; yet these worms were present in such numbers in two cases as to readily account for the sickness among the swine. A specimen sent from the lungs of a pig in West Brookfield was found to contain similar parasites to those found in the Dracut pigs.

Quarantines or reports of cases have been received from 24 farms in 19 cities and towns, while in 1903 36 reports were received, — a falling off of 12. Three quarantines were sent in because of tuberculosis, and one lot reported as having swine plague was found to have tuberculosis.

Two swine, one in Fairhaven and one in Charlton, were found on autopsy to have tuberculosis. On a farm in Pittsfield where the barns were burned with cattle that were known to have been suffering from tuberculosis, quite a large number of swine were quarantined in order to prevent the pigs from being sold to neighboring farmers, but they were released after six had been killed for pork and found to be entirely free from disease.

In addition to swine that were quarantined for tuberculosis, there have been quite a number condemned this fall and winter as unfit for food because of their being infected with this disease. It seems to be quite common among swine kept in contact with tuberculous cattle, or fed skim milk and buttermilk from creameries supplied by tuberculous cows. A creamery owner in New Hampshire sent 100 pigs to one of the pork packers near Boston last spring, and 19, or nearly 20 per cent, were found to be so badly diseased with tuberculosis as to be unfit for anything but the rendering tank.

In outbreaks of hog cholera or swine plague the quarantine is continued until the outbreak is over and the owner has disinfected the pens, permission being given to kill apparently healthy marketable pigs, subject to slaughterhouse inspection.

A reported outbreak of hog cholera in Stockbridge upon two farms seems to have been a pneumonia due to the swine being kept in cold, exposed pens as winter approached, which subsided, with the loss of only a few small pigs, after the animals had been transferred to warmer, more comfortable quarters.

Considering the manner in which swine are fed and cared for, the only wonder is that there is so little sickness and disease reported.

In connection with the diseases of swine, some cases of trichinosis among people may be mentioned in this portion of the report.

Last winter in Springfield there were 7 people taken ill through eating pork which was insufficiently cooked, infected with trichinæ. The trichinæ are small, spiral worms, known as *trichina spiralis*, sometimes found in the muscle fibres of pork. It does not take a very high degree of temperature to kill them; it is said that they die at 130° or 140° F.

Trichinosis is a rare disease in this part of the world, as most people cook their pork sufficiently to kill these parasites. In the case mentioned the victims were Italians. The pig from which the infected pork came was one that was killed in Agawam. An agent of the Cattle Bureau investigated the matter, and found that the infected pig had been kept on the premises of an Italian in Agawam where there were 39 other swine. The inspector of animals for Agawam quarantined all the friends and relations of the dead pig, sending a duplicate notice to the office of the Cattle Bureau. As trichinosis in swine is not one of the diseases specified as contagious in section 28 of chapter 90 of the Revised Laws, and as the quarantined swine showed no evidence of disease, it was not thought necessary to continue the quarantine, and a release was sent to the owner.

An outbreak of a disease of this kind is one that emphasizes the necessity for a better inspection of meats and provisions, rather than any legislation in connection with contagious diseases of animals.

RABIES.

For the past few years rabies has occurred so seldom in Massachusetts as to be practically unknown. Two animals reported early in the summer as suspected of having rabies proved not to have the disease, upon the result of inoculation of rabbits.

One of these dogs was reported last July by Dr. W. A. Sherman, the inspector of animals in Lowell, who sent the head to Dr. Frothingham, who inoculated rabbits from the brain and cord. Ninety days later the rabbits were still healthy.

The other case was reported by Dr. W. M. Simpson, the inspector of animals in Malden. He sent the head of the dog to a friend connected with the New York City board of health, who reported to him that rabbits inoculated had failed to develop the disease.

A case of suspected rabies was reported by Dr. Alex. Burr, early in November, as dying at the veterinary hospital at 50 Village Street, Boston. Dr. Burr found that this animal was owned in Somerville. The remains were turned over to the Cattle Bureau, and the rabbits inoculated at the Harvard Medical School by Dr. Frothingham developed rabies December 2. There is no history of this dog having been in a fight or having been bitten by any other dog, and, as far as known, he did not do any damage after developing symptoms of disease.

Since the close of the year, December 15, another dog has been reported, by Dr. A. W. Draper of Milton, on suspicion that it had rabies. This dog was killed, and its head taken to the Harvard Medical School for Dr. Frothingham to use in inoculating rabbits. It is feared that this will prove a case of rabies, although it is too soon to give a final report on it. This case, however, does not properly belong in the work of 1904, as it was reported after December 15.

It is to be regretted that these cases have occurred, as it was hoped that the State was free from this disease. There has been a great deal of trouble in New York State during the past summer, due to the prevalence of rabies in certain sections there; and if the disease should be brought into Massachusetts, and become as prevalent here as it was eight or ten years ago, it might prove a very serious matter.

If this State should be so unfortunate as to be visited by an outbreak of rabies this spring, it is not amiss at this time to remind all persons that if a case of suspected rabies occurs, the dog should be immediately isolated and the case reported at the office of the Cattle Bureau; or, if it dies, the head should at once be sent, in as fresh and clean a condition as possible, to the Cattle Bureau office for examination. This is especially important if a person is bitten, because by inoculating rabbits it can be ascertained positively whether the dog had this disease or not; and if it is found that the animal had rabies, the person bitten can go to New York and take the Pasteur preventive treatment; if it is found that the dog did not have rabies, there is no necessity for the person bitten undergoing the preventive treatment.

Recently it has been discovered that there are changes in certain ganglia of nerve cells near the base of the brain, known as the cervical ganglia, in dogs that have rabies. In urgent cases, where a person has been badly bitten and there is a delay in commencing the examination, an opinion can be formed by an examination of these cells as to whether the person bitten should immediately receive the Pasteur preventive treatment, without waiting to see whether inoculated rabbits develop rabies or not. The rabbit test, however, is the most exact. If a dog has rabies, and rabbits are inoculated intracranially, in the course of twelve or fourteen days they will develop rabies; if the rabbits remain healthy, it is certain that the dog or other suspected animal from which the material was taken for inoculation was not mad.

When it is possible, a dog suspected of having rabies should be caged, so that it cannot do any damage before it dies or is chloroformed. Destroying it by shooting is not desirable for scientific work, as the bullet rends and tears the brain and carries foreign material into it, so that it is of less value for purposes of inoculation than if it were intact and uninjured. The practice of shooting a dog that is acting in a peculiar manner, on the appearance of the first symptoms of any unusual condition, and calling it mad, cannot be too strongly condemned, as there is then no foundation upon which to base an opinion as to whether the animal was suffering with rabies, or whether some other condition existed, and it is an injustice to the dog. The only exact way to decide whether a dog has rabies or not is to have a scientific examination made, as described above. This is particularly necessary if the dog in question has bitten any persons or other dogs.

At times when there is any danger of an outbreak of rabies, the dog-licensing law should be rigidly enforced by the police authorities in every city and town (it always should be), and all ownerless, homeless and stray dogs should be caught and destroyed.

If an outbreak of rabies should occur in any town, any dogs that have been bitten by a rabid one should be quarantined for ninety days; and in some instances it is necessary to have all dogs running at large properly muzzled.

By carrying out this method in years past the State has been practically freed from this disease, and if it should reappear, similar measures would be productive in time of equally good results.

Sheep Scab.

At the time of making the semiannual report, in July, it was reported that sheep scab existed in a few small flocks of sheep in Groveland, West Newbury and Amesbury. The sheep had been dipped twice, under the supervision of an agent of the Cattle Bureau, and released from quarantine. Since then no further complaints of trouble from this disease have been made.

The sheep dip first used was a lime and sulphur dip, which was made according to one of the formulas of the United States Bureau of Animal Industry. This contains 24 pounds of flowers of sulphur and 8 pounds of unslacked lime to 100 gallons of water. The lime is first slacked with a small quantity of water, then the sulphur is added and stirred in with sufficient water to make a paste; 30 gallons of water are added, and the mixture should then be boiled for two hours; after it has been boiled this length of time, water sufficient to make 100 gallons is added; it should then stand until it becomes clear, and the clear fluid on top should be drawn off, leaving all sediment at the bottom of the vessel.

The fluid should be used at a temperature of 105°, and each sheep should be held in the dip for two minutes. If necessary, this should be repeated in ten days. This is found to be a very efficient sheep dip for killing the scab parasite, and, furthermore, it has not been found to injure the quality of the wool. The objection to it seemed to be that when prepared by inexperienced persons the hands were blistered by the mixture of quicklime and sulphur; and for this reason, in the instances mentioned above, it was found necessary later to furnish the owners with a proprietary preparation known as "McDougall's sheep dip," which seems to answer the purpose equally well, and with no danger of disagreeable consequences to the users.

ACTINOMYCOSIS.

Actinomycosis, or "lumpy jaw," as it is called when the disease invades the jaw bone of an animal, is caused by a small fungus known as *actinomyces*. Several cases are reported to the Cattle Bureau every year, but during 1904 a few more than usual have been sent in.

Early in the year a cow was killed in Plymouth because of tuberculosis. The udder was also nodulated. The specimen examined by Dr. Frothingham proved the lesions to be due to actinomyces. A curious coincidence occurred in the same town a little later. A specimen of the mammary gland of a sow which was killed for food was sent to the Cattle Bureau office by the inspector of animals, the inspector asking whether the sow had tuberculosis, and whether the meat ought to be condemned or not. When this specimen was examined microscopically, the lesions were found to be due to actinomyces.

Two cows with nodulated udders were quarantined in the autumn by the inspector of animals for the city of Boston, as having actinomycosis of the udders. They were found to have nodulated udders. The milk was examined under the microscope, but no actinomyces could be found in it, neither were any tubercle bacilli to be found. The cows were tested with tuberculin and failed to react, and were released, as it seemed that the lesions were very probably due to former attacks of mammitis. The inspector of animals for the city of Boston also reported two cows with actinomycosis that were killed, with the consent of the owner.

There were two cases reported in Goshen. One animal was in good beef condition, and was released, the owner intending to kill it for beef a little later; the other was emaciated, and was being traded from one person to another, and therefore it was ordered killed.

A cow in Brookline with lumpy jaw was emaciated and unable to eat, and was ordered killed, as was also one in Canton. A suspected case reported in Bridgewater was found upon examination not to be suffering from actinomycosis, and was released.

Cases were also reported in Ashby and Cheshire, both of which were released without being ordered killed, the owners agreeing to kill them later. The one in Cheshire was in fair condition, and the owner wished to fat the animal three or four weeks longer, when he was going to kill it for beef, and agreed to bury the head.

Symptomatic Anthrax.

Two outbreaks of symptomatic anthrax, or what is more commonly known as blackleg, were reported early in the summer of 1904. One of these occurred in the Woodward pasture in Ashby, the other in Princeton. This disease has been found in the Woodward pasture in previous years, but there had not been any trouble there for two years, until last June. Forty-eight head of cattle were turned into this pasture in the spring; 4 young cattle died in June, leaving 5 cows over three years old and 39 head of younger cattle.

The 39 young animals were given preventive inoculation with the Parke-Davis "blacklegoids," by Mr. Dennen and Dr. C. B. Shaw, the inspector of animals, and those that died were buried. No more cases occurred among the young cattle, but an owner of one of the older cows reported in the autumn that he had lost a young cow which he thought died of the same disease as the young cattle. It was explained to him that the older animals were not given a protective inoculation, as usually mature animals seemed to be immune from the disease; and it was regretted, for his sake, that the young cow he lost did not happen to enjoy immunity.

Cases have been reported in Princeton and Hubbardston during previous years, but there had not been any trouble in these places worth mentioning for the past two or three seasons, until last spring. In May Dr. J. Hayden Stimson, the inspector of animals in Princeton, reported that 6 young cattle had died in a pasture owned by a farmer in Sudbury. Dr. A. S. Cleaves of Gardner, an agent of the Cattle Bureau, was sent to Princeton with a supply of "blacklegoids," and the necessary instrument for placing them under the animals' skins. He found that originally there had been 22 animals in the pasture, of which 6 had died. Protective inoculation was given to 10 head, 9 of them between eight and eighteen months old, and 1 a four-year-old cow. There were 6 older cows in the pasture which were not inoculated, as Dr. Cleaves was of the opinion that they were old enough to be immune from the disease. The animals given protective inoculation did well, and no further deaths have been reported.

A case supposed to have been symptomatic anthrax was reported in Leominster in July, in a cow; but upon investigation it was thought that she died from being overheated.

TEXAS FEVER.

There has not been an outbreak of Texas fever in Massachusetts since the summer of 1902. During the summer months any cattle that are brought from infected districts in the west for slaughter are forbidden by law to be driven upon the highways in this State. If any Texas cattle are brought here, the railroad company is obliged to run the cars containing them on side tracks directly to the abattoirs. As cattle from the quarantined districts are sometimes brought to the Brighton abattoir during the summer months, no one is allowed to drive any neat cattle upon the abattoir premises unless they are intended for immediate slaughter.

Early in September a man in Wellesley drove 5 cows, which he was taking from Brighton to Wellesley, through the abattoir grounds, with the intention of shipping them later to Hancock, N. H. The main road was being repaired, and in order to get them on another road he used the abattoir grounds as a short cut. These cattle were therefore quarantined upon the premises of the Wellesley man for two weeks, in order to be sure that there was no danger of their having Texas fever. Nineteen cows and a bull on the same premises were also quarantined for the same length of time, in order to be sure that no animals were moved on or off the premises. It was so late in the season that there was not much danger from these cattle. If they had picked up young ticks and become infected with Texas fever, it would have been so late in the autumn, by the time any young ticks could have developed into adults and dropped off and laid eggs, that frosty weather would have arrived before the eggs could have hatched; and therefore there was no danger of any young ticks spreading the disease to the cattle with which the 5 cows that had been exposed were kept.

Two weeks later, September 21, 10 head of interstate cattle, which were being driven from the yards of the New England Dressed Meat and Wool Company, in Somerville, to the Brighton market, were driven onto the grounds of the Brighton Abattoir Company, because of the employee who was driving them not understanding the law, although posters are put up every spring on the premises of this company, forbidding persons driving any cattle through them. These cattle were sent back to the New England Dressed Meat and Wool Company's yards and held in quarantine for two weeks. At the end of that time, as they were healthy, they were tested with tuberculin and released, and allowed to be sold at Brighton October 5. While there was little or no fear of any bad results ensuing through these misunderstandings of the law in relation to Texas fever, at the same time, eternal vigilance is the price of good health among our live stock, and the only way to ensure it is by enforcing these laws and the necessary rules and regulations for protecting it.

HEMORRHAGIC SEPTICÆMIA.

In connection with hemorrhagic septicæmia, other septic infections may be included, where the cause of the infection is not altogether clear. Hemorrhagic septicæmia was first described by Dr. M. H. Reynolds of Minnesota, three or four years ago, and is a form of blood poisoning sometimes found among cattle of various ages. What was formerly called the "corn-stalk disease" in the west a number of years ago is, in all probability, a variety of septicæmia.

Several outbreaks of this disease, or sicknesses resembling it, have occurred during the past year. In May the inspector of animals of Princeton reported a number of sick cows kept upon a farm where the hay grown had been expended during the winter, and the animals were being fed upon baled clover hay from the west; 3 died out of a herd of 20. Dr. Frothingham made autopsies upon 2, and secured cultures, but did not succeed in isolating the germ of the disease, which is known as the *bacillus bovi septicus;* but he believed the trouble to have been this disease, or something similar.

Last June, at one of the colonies for feeble-minded boys, in Templeton, a number of fine heifer calves three or four months old, which were being raised, died with what was evidently a septic infection of some kind. The Chief of the Cattle Bureau visited the farm, with Dr. A. S. Cleaves of Gardner, June 14; saw 2 calves that were already dead, and in order to get fresh specimens killed a sick calf and made an autopsy. The posterior pharyngeal lymphatic glands and mediastinal lymphatic gland were enlarged, and there was a gelatinous mass of yellowish material on a portion of the mesentery supporting the duodenum; the calf also had pneumonia, but this may have been due to mechanical irritation of the lungs, as it had been given some Epsom salts in water, and may have gotten some down the trachea. Specimens from the spleen, kidneys, lungs, posterior pharyngeal, mediastinal and mesenteric lymphatic glands, and also some of the gelatinous material spoken of, were taken to Dr. Frothingham. He obtained cultures of two different organisms, either one of which would produce a fatal septicæmia in rabbits or guinea pigs, killing them in from one to three days. One of the forms of bacteria obtained resembled the *bacillus bovi septicus.*

In August, out of 10 young cattle running in a pasture in Uxbridge, 7 died. Dr. W. T. White investigated the outbreak, and found that 6 had been dead several days, and were so far decomposed that post-mortem examinations on them would have been of no value. One that had recently died was opened; the intestines were found to be inflamed, and the walls were studded with small, black, shot-like bodies. These were taken to the Harvard Medical School and examined by Dr. Frothingham, who was inclined to think that the animal had hemorrhagic septicæmia. Dr. White could not state whether all the animals died from the same cause, but the probabilities are that all were similarly affected.

In March a farmer in South Duxbury reported that his herd of 11 cows were sick. Dr. White investigated this outbreak, and found all the cows to be suffering from some intestinal trouble, 10 of them in a mild way from diarrhœa, 1 of them showing symptoms of inflammation of the bowels. The cattle had been sick a week when seen by Dr. White. The appearance of the indisposition occurred soon after opening a new stack of hay. It is not unlikely that something in the hay or food disagreed with the animals. The disease was apparently not one of a contagious character. The owner reported a few days later that his cattle were recovering, with change of food and proper care.

March 4, Dr. P. J. Mahoney reported cases of sickness in a herd of cattle on a farm in Northborough. The place was visited by Dr. Madison Bunker and the Chief of the Cattle Bureau. It was found that a cow and a bull had died a few days before, and that another cow was quite sick. There were several two-year-old heifers in the herd, which the owner said had been sick but had recovered. Part of the food of the animals was corn ensilage, which was cut late in the fall, after having been frost-bitten; and, as the result of the intense cold of the winter, the frost had penetrated quite a way into the silo. As the owner seemed to have plenty of hay and oat straw, he was advised not to feed any more of this ensilage, but to clean out the silo as soon as milder weather came, and plow the ensilage into the ground. This disease was probably a septic pneumonia, due to an organism similar to that producing swine plague or the corn-stalk disease. No further complaint from this farm has been received, and it is supposed that no more trouble followed.

Foot and Mouth Disease.

There has been no foot and mouth disease in the United States since the last cases occurred at Wakefield, in August, 1903, but an occasional echo is heard. Cases of foot and mouth disease were reported during the spring from Sheffield, Holbrook and Carlisle. When investigated by agents of the Cattle Bureau, the suspected cattle were found to be suffering with ordinary foot rot.

Takosis.

At the time of the report made a year ago takosis was spoken of as an infectious disease occurring in goats, — especially the Angora goat, — mentioned in the nineteenth annual report of the United States Bureau of Animal Industry. During the winter and spring sick goats have been reported in two flocks, one at Mansfield, the other at Southville, in the town of Holliston. Investigation by Dr. Frothingham has not enabled him to decide that any of these animals had takosis. It was also thought that the trouble might be due to a stomach worm (*strongylus contortus*) among the Southville goats, but this parasite was not found; if present, it may have become disorganized in the contents of the stomach after the goats died, too long an interval having elapsed between the death of the goats and the autopsy to be sure whether they were suffering from this parasite or not. It was not very clear at first what the animals died of, but it may possibly have been partly due to change of food and climate.

Some people seem to have become imbued with the idea, from reading about the Angora goat, that it will thrive without any care and upon any kind of food. In reality, it is doubtful if any species of domestic animal will thrive if neglected or improperly fed; and if any one hopes to make a success of the goat industry, he should take the same care of and feel the same interest in the goats that he would in any other live stock.

MANGE AMONG HORSES.

Mange in horses has been more common during the past year than heretofore. Cases have occurred in North Attleborough, Grafton, Milford and Chelmsford. It would seem, therefore, to be more widely spread than at the time of the report made a year ago.

An animal slightly affected and in good condition readily yields to treatment. The parasite can be killed with preparations of lard and sulphur, or kerosene emulsion, or a solution of sulpho-naphthol and water. Old horses having the disease and neglected by the owners become so run down as to be practically worthless. One reported in Grafton died, and the one in Chelmsford was sent by the owner to the rendering works to be killed.

Stalls where horses with mange have been kept should be disinfected, and harnesses and utensils should also be cleansed and disinfected when an animal with mange is killed and replaced by a healthy horse.

CONTAGIOUS OPHTHALMIA.

During the summer there was an outbreak of a form of contagious ophthalmia among neat cattle. The first cases were reported from Westborough; it also occurred in adjoining towns, and later a herd was reported as affected in Needham.

This disease was first described as *keratitis contagiosa* by

Dr. F. S. Billings, when he was connected with the Nebraska University in 1889. It has apparently not been infrequent in the west during the past summer, as the veterinary column of the "Breeders' Gazette" has had a number of inquiries from subscribers, asking what to do for cattle having trouble with the eyes. Dr. Billings speaks of the disease as causing considerable fever; much pain in the eyes, apparently; a loss of appetite; and a shrinking in the quantity of milk given, where it attacks milch cows.

The cases observed in Massachusetts during the past summer do not seem to have caused the animals any trouble beyond weakness of the eyes, and blindness in bad cases where both eyes were affected. The appetite seemed to be good, and there was little or no diminution in the quantity of milk given by the cows which had the disease. Most of the animals had it in one eye. The eye appeared weak, tears running from it, and the cornea was cloudy and opaque. In very bad cases the anterior chamber appeared to be yellow, as though containing pus, and occasionally the cornea would become ulcerated.

It did not seem to be a disease that was sufficiently serious to call for quarantine measures. The treatment indicated is to keep animals affected in a dark stable while the attack lasts, bathing the eyes twice a day with a saturated solution of boric acid in warm water. It is better to use absorbent cotton, which can be thrown away and burned, using a different bit for each animal, rather than to use a sponge, which may be unclean and contain all kinds of germs. When the cornea is ulcerated, powdered boric acid, two parts with one part of calomel mixed together, may be blown onto the ulcerated surface once or twice a day. In most of the cases where this trouble occurred it is not likely that the owners took even as much pains with the animals as has been recommended above.

At the time of the outbreak of contagious ophthalmia the following letter was written to the Attorney-General, not altogether to find out what authority the Chief of the Cattle Bureau had in this particular outbreak, which did not seem to call for any special interference from him, but more with a view to ascertain what authority, if any, he would have if some more serious disease appeared among the live stock of the State which was not specified as a contagious disease in section 28 of chapter 90 of the Revised Laws.

BOSTON, MASS., July 19, 1904.

Hon. HERBERT PARKER, *Attorney-General, State House, Boston.*

SIR: — Chapter 90 of the Revised Laws refers to the contagious diseases of animals; section 28 specifies what contagious diseases are recognized within the meaning of this act; section 4 of chapter 90 of the Revised Laws, as amended by section 3 of chapter 116 of the Acts of 1902, provides that the Chief of the Cattle Bureau, with the approval of the Governor and Council, may from time to time make orders and regulations relative to the prevention, suppression and extirpation of contagious diseases of domestic animals.

I would be very much obliged to you if you would inform me how much power the Chief of the Cattle Bureau has to issue rules and regulations for the prevention, suppression, extirpation, etc., of a contagious disease not recognized as such by the act relating to contagious animal diseases.

For example, at the present time a disease of the eye has appeared among cattle in the town of Westborough, apparently of a contagious character, spoken of by some writers upon veterinary matters as *enzoötic ophthalmia,* and by others as *contagious keratitis.* While it does not seem to be dangerous to cattle or a menace to the health of the human family, nevertheless, it may prove very troublesome to some cattle owners, and occasionally deprive an animal of the sight of one or both eyes. I am, therefore, anxious to know what authority I have, if any, for quarantining, isolating and forbidding the sale of animals from herds where the disease exists, until the danger of conveying it is over.

Very respectfully, your obedient servant,

AUSTIN PETERS,
Chief of Cattle Bureau.

The following reply was received: —

BOSTON, Oct. 10, 1904.

AUSTIN PETERS, Esq., *Chief of the Cattle Bureau.*

DEAR SIR: — Your letter of July 19 calls for my opinion upon the question whether a disease of the eye, known as *enzoötic ophthalmia,* which has attacked certain cattle in the town of Westborough, is a contagious disease within the meaning of the definition of that term contained in Revised Laws, chapter 90, section 4. The disease in question is stated to be apparently contagious, but not dangerous to the animals attacked by it or to the health of persons who may be brought into contact with it. Upon these facts you inquire specifically whether there is any legal authority in the chapter above referred to, as amended by Statutes of 1902, chapter 116, section 3, for isolating and forbidding the sale of animals from herds where such disease exists, until the danger of contagion is over.

Assuming that the disease in question is in no respect dangerous to mankind, I am of opinion that you have no jurisdiction in the premises. The evident purpose of the statute was to protect and preserve the health of persons purchasing the several products derived from domestic cattle; and it was not intended to relieve the owner of cattle from the responsibility of their care and maintenance or to preserve the health of the cattle themselves. The diseases specifically enumerated in section 28 of chapter 90 of the Revised Laws appear to be contagious diseases which affect the products derived from cattle, either milk or meat, and through them the health and safety of the persons by whom they are consumed. The powers vested in the officers of the Cattle Bureau, in the case of the contagious diseases enumerated in the statute, are very broad, and for that reason are not, in my opinion, to be extended by implication to diseases other than those specifically mentioned in section 28.

Very truly yours, HERBERT PARKER,
Attorney-General.

It appears from the above that only the diseases specified as contagious within the meaning of the act can be legally dealt with by the Chief of the Cattle Bureau.

Mange among horses and dogs is more prevalent than formerly in Massachusetts. Mange among cattle is causing a great deal of annoyance and inconvenience to cattle owners in the west. If cattle mange should appear in this State, or any new or unthought-of contagious animal disease, the Chief of the Cattle Bureau would not have the authority necessary to cope with an emergency of this kind. The law should be amended so as to include some of these other diseases, in case an emergency called for State control, or the law should be broad enough to include all diseases of domestic animals of a communicable, infectious or contagious nature.

In making an estimate for the appropriation needed for the use of the Cattle Bureau during the ensuing year, the Auditor has requested that the items be specified under the different acts calling for appropriations. In compliance with his request, the estimate has been based upon the following provisions of the law: —

Chapter 116 of the Acts of 1902 provides for the appointment of Chief of Cattle Bureau, with a clerk, and allows for travelling and other necessary expenses, including extra clerks, stenographers, stationery, printing and other office expenses. The sum of $7,000 has been stated as the amount necessary for this purpose.

Chapter 322 of the Acts of 1903 provides that tuberculin tests upon animals brought into Massachusetts from without the State shall be made free of expense to citizens of this Commonwealth. The sum estimated as needed for this purpose is $12,000, if the expense of maintaining the quarantine stations at Brighton, Watertown and Somerville is included as coming under the provisions of this act.

For the extermination of contagious diseases among domestic animals, as provided for in chapter 90 of the Revised Laws, it is believed that $65,000 could be spent to good advantage in endeavoring to still further diminish contagious animal diseases in this State. The total amount estimated, therefore, is $84,000.

Respectfully submitted,

AUSTIN PETERS,
Chief of Cattle Bureau.

FOURTEENTH ANNUAL REPORT

OF THE

DAIRY BUREAU

OF THE

MASSACHUSETTS BOARD OF AGRICULTURE,

REQUIRED UNDER

CHAPTER 89, SECTION 12, REVISED LAWS.

JANUARY 15, 1905.

DAIRY BUREAU—1904.

CARLTON D. RICHARDSON, West Brookfield, *Chairman.*
JOHN M. DANFORTH, Lynnfield Centre.
HENRY E. PAIGE, Amherst.

Secretary.
J. LEWIS ELLSWORTH, *Executive Officer and Secretary of the State Board of Agriculture.*

General Agent.
P. M. HARWOOD.
Address, Room 136, State House, Boston.

REPORT.

In reviewing the work of the Dairy Bureau for the past few years one can but notice the different conditions which it has been called upon to meet, particularly along the line of police duties. In its early history the larger part of the work was in the prosecution of oleomargarine dealers. Later, renovated butter came to the front; this was followed by a curtailment in the oleomargarine trade. Last year violations of the renovated butter law reached a climax, and when it was found that the law was being enforced the dealers became more law-abiding, until to-day we have a healthier condition of law observance on the part of both oleomargarine and renovated butter dealers than we have had for some years. Another phase of work has appeared this year, as a result of which we have had 55 cases in court for the adulteration of cream with formaldehyde.

During the four years next preceding the one covered by this report there were many violations of law discovered, and these seemed to increase in number, though varying in kind, until last year the maximum of cases in court (289) was reached. The annual number of inspections has also constantly increased, until this year, the State being covered more systematically and thoroughly than ever before, we have found but 168 cases of violation of law to enter in court.

The matter of educational work has been entered into more fully than formerly, with future promise of increased work along that line; and the Bureau has purchased special equipment for the purpose of giving stereopticon lectures and instruction upon questions relating to better production, care, handling and a more rational consumption of dairy products.

There has been but one change in the membership of the Bureau. Mr. A. M. Lyman, whose term as a member of the Board of Agriculture expired in January, became no longer eligible, and was succeeded by Dr. Henry E. Paige. Mr. C. D. Richardson has continued as chairman and Mr. P. M. Harwood as general agent. Mr. A. W. Lombard has been regularly employed as agent, and five others have been temporarily employed, as occasion required. Most of the chemical work has been done by Dr. B. F. Davenport, although three other chemists have been incidentally employed in some of the oleomargarine cases.

The general agent has acted as judge in special dairy tests at two fairs, Sturbridge and Palmer; and, by special appointment by the Governor, was sent as delegate to the Pure Food Congress at St. Louis, September 26 to October 1, inclusive.

The work of the year has been as follows: —

Total number of inspections,	*5,594
Number of inspections where no samples were taken,	4,456
Number of samples of butter and oleomargarine, nearly all purchased,	887
Number of samples of milk and cream,	270
Cases in court,	168
Meetings addressed by the general agent,	28
Meetings addressed by the chairman of the Bureau,	15

Cases prosecuted during the year, by months and courts, with law violated, and results, are as follows: —

COURT.	Month.	Number.	Law violated.	Convicted.	Discharged.
Lowell, .	January, .	4	Oleomargarine, .	4	–
Quincy, .	January, .	4	Renovated butter, .	4	–
Cambridge, .	January, .	5	Renovated butter, .	5	–
Malden, .	January, .	2	Renovated butter, .	2	–

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* Nineteen extra samples were taken during inspections, therefore this total is nineteen less than the sum of the next three items.

COURT.	Month.	Number.	Law violated.	Convicted.	Discharged.
Haverhill, .	January, .	2	Renovated butter, .	2	–
Abington, .	February, .	2	Renovated butter, .	–	2
Waltham, .	February, .	2	Oleomargarine, .	2	–
New Bedford, .	February, .	20	Renovated butter, .	20	–
Newburyport, .	February, .	4	Renovated butter, .	4	–
Attleborough, .	March, .	2	Renovated butter, .	2	–
Brockton, .	March, .	6	Renovated butter, .	6	–
Worcester, .	March, .	4	Renovated butter, .	4	–
Lowell, . .	April, .	2	Renovated butter, .	2	–
Taunton, .	April, .	2	Renovated butter, .	2	–
Gloucester, .	May, . .	2	Renovated butter, .	2	–
Clinton, . .	May, . .	1	Oleomargarine, .	1	–
Lowell, . .	May, . .	1	Oleomargarine, .	1	–
Worcester, .	June, . .	3	Oleomargarine, .	3	–
Waltham, .	June, . .	1	Oleomargarine, .	1	–
Lowell, . .	June, . .	2	Oleomargarine, .	2	–
Boston, . .	June, . .	3	Oleomargarine, .	3	–
Lowell, . .	June, . .	1	Oleomargarine, .	1	–
Boston, . .	June, . .	8	Milk, . . .	8	–
Lawrence, .	August, .	1	Oleomargarine, .	1	–
Chelsea, . .	August, .	2	Renovated butter, .	2	–
Lawrence, .	September, .	9	Milk, . . .	9	–
Worcester, .	September, .	2	Oleomargarine, .	2	–
Cottage City, .	September, .	5	Milk, . . .	5	–
New Bedford, .	October, .	14	Milk, . . .	14	–
Fall River, .	October, .	12	Milk, . . .	12	–

Court.	Month.	Number.	Law violated.	Convicted.	Discharged.
Attleborough, .	October, .	14	Milk, . . .	14	–
New Bedford, .	November, .	4	Milk, . . .	4	–
Plymouth, .	November, .	7	Milk, . . .	7	–
New Bedford, .	December, .	10	Renovated butter, .	10	–
New Bedford, .	December, .	1	Oleomargarine, .	1	–
Worcester, .	December, .	4	Renovated butter, .	4	–
		168		166	2

The charges in the several cases in court for the year have been as follows: —

Selling renovated butter in unmarked packages, ...	73
Oleomargarine in imitation of yellow butter, ...	20
Oleomargarine served in restaurants without notifying guests, .	2
Milk adulterated, ...	55
Milk below standard, ...	18
Total, ...	168

The following is a list of inspections without samples and the number of samples taken in the years 1900–1904 inclusive: —

Year.	Inspections without Samples.	Samples taken.
1900, ...	1,612	826
1901, ...	1,757	911
1902, ...	3,895	1,078
1903, ...	4,135	1,395
1904, ...	4,456	1,157
Totals, ...	15,855	5,367
Averages, ...	3,171	1,073+

The following is a list of the number of cases entered in court and also the number of convictions secured in the years 1900–1904 inclusive: —

YEAR.	Total Cases.	Convictions.
1900,	178	144
1901,	252	218
1902,	285	238
1903,	289	272
1904,	168	166
Totals,	1,172	1,038
Average convictions,	-	208—

OLEOMARGARINE.

The oleomargarine situation is always a matter of public interest. Considered on its merits, oleomargarine is one thing; as a counterfeit of butter, it is quite another. As showing the effect of the United States law of 1902, the following figures are of interest. The total output of oleomargarine in the United States for the year ending June 30, 1902, was 126,316,472 pounds; while that for the year ending June 30, 1904, was 48,071,480 pounds. Of this latter amount, only 1,639,102 pounds paid the ten-cent tax as colored goods. As showing the combined effect of the United States law and the enforcement of the State laws, the whole number of licenses as per last year's report was 352; this year 151, — a falling off of 201; a shrinkage of 76+ per cent in the number of "colored" and of 55— per cent in the number of "uncolored" licenses.

Notwithstanding this decrease, and the fact that oleomargarine can be sold uncolored under certain restrictions in this State, there have been attempts to violate the laws, both State and national. Three Rhode Island factories tried this in the early part of the year. Some of our chemists succeeded in discovering the presence of extraneous coloration, and the Bureau immediately set about prosecuting the dealers for selling oleomargarine in imitation of yellow butter. This was followed by the United States Internal Revenue Department taking action, with the result that two of the factories went out of business, the other apparently mending its ways. Obviously, this is a business that will bear watching at all times.

The number of persons who paid a United States tax the past three years is shown by the following table: —

YEARS ENDING JUNE 30.	Wholesale.	Retail.
1903 (colored),	1	24
1903 (uncolored),	7	314
1904 (colored),	–	17
1904 (uncolored),	9	326
Current year (colored),	–	4
Current year (uncolored),	9	138

RENOVATED BUTTER.

Undoubtedly butter will and should be renovated, as long as an inferior article, whether improperly made or improperly kept, exists. The business has grown, until, according to Secretary Wilson's report, 54,000,000 pounds was the product of the year ending June 30, 1904. Much of this is sold in such form that there can be no mistaking what it is; sometimes, however, it is sold for butter, put up in plain, unmarked wrappers. This latter method the law expressly forbids, and our prosecutions have been where such practices occur; and never, during the last two years, have we put a case in court where there were not two or more violations of the law, tending to show that it was the actual practice of the offender, and not an accident.

EDUCATIONAL.

As has already been intimated, the Bureau is doing what it can to educate towards the production of clean milk, to better methods of handling, and to a better care of milk and its products in the hands of the purchaser. We have endeavored to lose no opportunity to enforce this idea upon the public. We believe there is improvement year by year, but recognize that there is room for more.

The producer naturally thinks that, if he could get a better price for his milk product, he could then afford to take more pains with it, which is undoubtedly true; and the consumer owes it to himself, to his family and to the welfare of everybody, not so much to question the price of milk and cream, within certain limits, as to insist upon its quality and condition. No one ought to expect milk containing 5 per cent fat for the same price as that containing 3.7 per cent fat. The producer ought to be able to sell his milk on its merits, just the same as the dry goods merchant does his cloth; and this should apply to freedom from deleterious bacteria, as well as to fat content. It seems as though an adjustment of prices along this line would assure to the consumer clean milk, and give the producer encouragement to produce better goods, and also a fair remuneration for his labor.

At the same time, it should be recognized that there is more than one way to increase income; and that clean milk, clean cream and first-class butter or cheese will increase consumption, and thereby enlarge the market for these most desirable articles of food. Many a business man has succeeded by increasing his production to a paying point without increasing the price.

Habits of cleanliness are not so expensive as they are hard to form; but, when once formed, it is believed that they pay for themselves in one's increased standing, reputation, improved physical health, mental power and moral worth; all of which contribute not only to happiness, but increase earning power as well.

Much of the cream brought into our market to-day comes from without the State. Most of this is pasteurized cream. In a smaller way a still better product is produced under superior sanitary conditions, such, in fact, that the cream keeps readily ten or more days, and with no other treatment than to keep it sufficiently cool and tightly sealed. Some dealers warrant such cream to keep sweet two weeks, if held at or below 50° Fahrenheit. The use of bottles, in sizes suited to the wants of the customer, in handling milk or cream, is of great advantage: first, because standard milk thus put up must still analyze to law requirements; second, because of convenience in handling; third, milk or cream put up in such manner need not be opened until ready for use; and the consumer who wants the best of milk will never unseal a can or bottle until it is wanted, and will not allow unsealed bottles of milk or cream to stand in or out of a refrigerator for any considerable length of time.

It should not be overlooked that we are only a little more than twenty-four hours distant from the great milk-producing centre of our country, where the cost of production is less than here; and that the day has now arrived when sanitarily produced cream can be shipped long distances, and in such condition that it will keep sweet a week or more after arrival, if properly cared for. Our local cream, however, prepared under like conditions, is good for some hours or days longer, and our cost of transportation less. Massachusetts to-day does not send beyond New England and New York State, except for pasteurized cream, some thousands of gallons of which are brought from Iowa; but she does send considerable sums of money to her neighbors for cream which keeps well, for the reasons above given, and which, much of it, could be profitably produced within our own borders. It seems as if Massachusetts producers could get a larger share of this trade if they pushed for it.

The chairman of the Bureau has delivered fifteen and the general agent twenty-eight lectures, bearing upon dairy topics, during the year.

BUTTER.

There has been, according to the best reports available, a large increase in the annual production of butter in this country, — probably ten per cent and possibly more in the last two years. Ten per cent of the product of June 30, 1902, to June 30, 1903, which was estimated at 1,500,000,000 pounds, would amount to 150,000,000 pounds; the falling off of the oleomargarine product of 78,000,000 pounds, which it took an equal amount of butter to replace, would leave a net increase of 72,000,000 pounds of butter for the year 1903–1904 to depress the market. Then, too, the 54,000,000 pounds of renovated butter, elsewhere referred to, comes much nearer competition with creamery butter than would that which was renovated. This accounts to a considerable extent for the ruling low price, and argues that the farmer has not only had a larger market for his butter, but the consumer has not been obliged to pay an extra price for it.

The following table shows the extreme quotation for the best fresh creamery butter in a strictly wholesale way in the Boston market for the last eight years: —

	1904. Cents.	1903. Cents.	1902. Cents.	1901. Cents.	1900. Cents.	1899. Cents.	1898. Cents.	1897. Cents.
January, . .	22.70	28.00	25.0	25.0	29.5	21.0	22.5	22.0
February, . .	24.60	27.00	28.5	25.0	26.0	24.0	21.5	22.0
March, . .	24.10	27.00	29.0	23.0	27.0	22.5	22.0	23.0
April, . . .	21.60	27.50	32.0	22.0	21.0	21.0	22.5	22.0
May, . . .	19.90	22.50	25.0	19.5	20.5	19.0	18.0	18.0
June, . . .	18.40	22.75	23.5	20.0	20.5	19.0	17.5	16.0
July, . . .	18.30	20.50	22.5	20.0	20.5	19.0	18.5	16.5
August, . .	19.10	20.00	21.5	21.0	22.5	21.5	19.5	19.0
September, . .	20.80	22.00	23.5	22.0	22.5	23.5	21.0	22.0
October, . .	21.50	22.50	24.5	21.5	22.0	24.0	21.5	22.5
November, . .	24.10	23.50	27.0	24.0	25.0	26.5	21.0	22.0
December, . .	25.70	24.50	28.5	24.5	25.5	28.0	21.0	23.0
Averages, .	21.73	26.23	25.0	22.3	23.5	22.4	20.5	20.6

The Chamber of Commerce's figures regarding the butter business in Boston for 1903 and 1904 are as follows: —

	1904. Pounds.	1903. Pounds.
On hand January 1,	7,567,360	6,248,920
Receipts for the year,	55,435,207	54,347,056
Total supply,	63,002,564	60,595,976
Exports, deduct,	1,373,815	842,692
Net supply,	61,628,749	59,753,284
Stock on hand December 31, deduct,	5,612,592	7,567,360
Consumption,	56,016,157	52,185,924

MILK.

The wholesale price of milk in Boston the past year has been the same as in 1903, and with but few exceptions the retail price the same. If the condition of milk as it leaves the farm or arrives in the market is on the whole improving year by year, it is largely attributable to the agitation of the clean milk question by those especially interested.

As to violations of the milk laws, this department has been called upon to do more work than usual. In conjunction with Dr. Harrington 8 cases were brought in Boston, and with Milk Inspector Scanlon of Lawrence 9 cases in that city; 55 cases for formaldehyde in cream were brought in Cottage City, New Bedford, Fall River, Attleborough and Plymouth.

The following tables show the wholesale prices of milk sent to the Boston market for the last ten years: —

Summer Price.

	Gross Boston Price. Cents.	"Straight Price," Boston. Cents.	Gross to Producer, Fifth Zone. Cents.	Straight Price to Producer, Fifth Zone.* Cents.
1895, April to October, .	33	-	22	-
1896, " " .	33	-	22	-
1897, " " .	31†	-	22	-
1898, " " .	31	-	22	-
1899, " " .	31	-	22	-
1900, " " .	33	-	24	-
1901, " " .	33	31	24	22
1902, " "	36 in April, July, August, September. 35 in May, June.	34 in April, July, August, September. 33 in May, June.	27 26	25 24
1903, " " .	37½	35½	28½	26½
1904, " " .	37½	35½	28½	26½

Winter Price.

1895-6, October to April,	37	-	26	-
1896-7, " "	35	-	24	-
1897-8, " "	33†	-	24	-
1898-9, " "	33	-	24	-
1899-0, " "	33	-	24	-
1900-1, " "	37 to January. 35 to April.	-	28 to January. 26 to April.	-
1901-2, " "	36 40 in December.	34½ 38½ in December.	27 31	25.5 29.5
1902-3, " "	39½	37½	30½	29
1903-4, " "	39½	37½	30½	28½
1904-5, " "	39½	37½	30½	28½

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* The price in the fifth zone, *i.e.*, the middle territory, is approximately the average price which the producers receive for their milk.

† This is a nominal rather than an actual change. With the dropping of the Boston price 2 cents the distance discount-schedule was also lowered 2 cents, so that producers received the same price.

Creameries and Milk Depots in Massachusetts.

LOCATION.	Name.	Co-operative or Proprietary.	Superintendent or Manager.
Amherst,	Amherst Creamery,	Co-operative,	F. J. Humphrey, agent.
Amherst,	Fort River,	Proprietary,	E. A. King.
Amherst,	Dairy School, Massachusetts Agricultural College.	Educational,	Prof. W. P. Brooks, director.
Ashby,	Ashby Creamery,	Proprietary,	C. Foster.
Ashfield,	Ashfield Creamery,	Co-operative,	Geo. G. Henry.
Belchertown,	Belchertown Creamery,	Co-operative,	M. G. Ward, president.
Boston, 494 Rutherford Avenue,	H. P. Hood & Son,	Proprietary,	H. P. Hood & Son.
Boston, 793 Boylston Street,	Walker-Gordon Laboratory Company.	Proprietary,	Walker-Gordon Laboratory Company.
Boston, 356 Rutherford Avenue,	D. Whiting & Sons,	Proprietary,	D. Whiting & Sons.
Boston, 388 Rutherford Avenue,	Boston Dairy Company,	Proprietary,	Boston Dairy Company.
Boston, 105 Holmes Avenue,	Hingham Dairy Association,	Proprietary,	Hingham Dairy Association.
Boylston,	Adelphia Creamery,	Proprietary,	E. M. Laws.
Bridgewater,	Plymouth County Creamery,	Proprietary,	H. A. Wilbor.
Cambridge, 158 Massachusetts Avenue.	C. Brigham Company,	Proprietary,	C. Brigham Company.

Charlemont,	Charlemont Creamery,	Proprietary,	T. M. Totman.
Cheshire (P. O., Adams),	Greylock Creamery,	Co-operative,	C. J. Fales, president.
Cheshire,	Highland Creamery,	Proprietary,	Clayton W. Prince.
Cheshire,	West Shore Creamery,	Proprietary,	Seth W. Curtis.
Chester,	Chester Creamery,	Co-operative,	W. S. Wilcox.
Conway,	Conway Creamery,	Co-operative,	W. A. Pease.
Cummington,	Cummington Creamery,	Co-operative,	S. W. Clark, president.
Easthampton,	Hampton,	Co-operative,	W. H. Wright, treasurer.
Egremont (P. O., North Egremont),	Egremont Creamery,	Co-operative,	H. O. Harrington.
Everett,	Hampden Creamery Company,	Proprietary,	Hampden Creamery Company.
Framingham (P. O., South Framingham).	Framingham Creamery,	Proprietary,	W. E. Marchent.
Fitchburg, 26 Cushing Street,	Fitchburg Creamery,	Proprietary,	G. S. Learned.
Gardner,	Boston Dairy Company,	Proprietary,	Boston Dairy Company.
Groton,	Lawrence Creamery,	Proprietary,	Myron P. Swallow.
Heath,	Heath Creamery,	Proprietary,	I. W. Stetson & Son.
Hinsdale,	Hinsdale Creamery,	Co-operative,	G. T. Plunkett.
Lee,	Lenox Creamery,	Proprietary,	P. A. Agnew.
Leominster,	Leominster Creamery,	Proprietary,	G. S. Wass.
Marlborough,	Este's Creamery,	Proprietary,	F. F. Este.

Creameries and Milk Depots in Massachusetts — Concluded.

LOCATION.	Name.	Co-operative or Proprietary.	Superintendent or Manager.
Monson,	Monson Creamery,	Proprietary,	W. C. Moulton.
Montague,	Montague Creamery,	Co-operative,	A. M. Lyman.
Monterey,	Berkshire Hill Creamery,	Co-operative,	Henry Clapp, treasurer.
New Boston,	Berkshire Creamery,	Co-operative,	F. M. Rugg.
New Salem (P. O., Millington),	New Salem Co-operative Creamery Company.	Co-operative,	W. A. Moore.
North Brookfield,	North Brookfield Creamery,	Proprietary,	H. A. Richardson.
Northfield,	Northfield Creamery,	Co-operative,	L. R. Smith.
Orange (P. O., North Orange),	North Orange Creamery,	Co-operative,	Jonathan Holt.
Oxford,	Cold Spring Creamery,	Co-operative,	C. H. Wellington.
Shelburne Falls,	Shelburne Falls Creamery,	Proprietary,	Rufus Covell.
Southborough,	Deerfoot Farm,	Proprietary,	S. H. Howes.
Southfield,	Maple Lawn,	Proprietary,	A. C. Lockwood.
Springfield,	Springfield Milk Association,	Co-operative,	F. B. Allen.
Springfield,	Tait Bros.,	Proprietary,	Tait Bros.
Uxbridge,	Farnum Creamery,	Proprietary,	Geo. A. Farnum.

Warren,	Worcester County Creamery Association.	Co-operative,	F. N. Lawrence, treasurer.
Westfield (P. O., Wybon),	Wyben Springs Creamery,	Co-operative,	C. H. Wolcott.
West Newbury,	West Newbury Creamery,	Co-operative,	R. S. Brown.
Williamsburg,	Williamsburg Creamery,	Co-operative,	E. T. Barrus, president.
Worthington (P. O., Ringville),	Worthington Creamery,	Co-operative,	M. R. Bates.
Worcester,	Wachusett Creamery,	Proprietary,	E. H. Thayer & Co.

EXPENSES.

The following is a classified statement of the expenses for the year: —

Bureau: compensation and travelling expenses,	$406 21
Agents: compensation,	1,584 75
Agents: travelling expenses and samples purchased,	2,438 54
General agent: travelling and necessary expenses,	581 02
Chemists: analyses, tests, court attendance,	1,100 00
Printing and supplies, including new outfit for educational work,	591 18
Educational,	298 30
Total,	$7,000 00

P. M. HARWOOD,
General Agent.

Accepted and adopted as the report of the Dairy Bureau.

CARLTON D. RICHARDSON.
JOHN M. DANFORTH.
HENRY E. PAIGE.

FIRST ANNUAL REPORT

OF THE

STATE FORESTER.

REPORT OF THE STATE FORESTER.*

To the General Court.

The first annual report of the State Forester covers a period of less than six months. The act which established the office did not go into effect until the first of last July. At the time of my appointment I was State Forester for Connecticut, and I could not get relieved from the duties of that position until the 12th of August, when I qualified for the position in Massachusetts; so the report which follows covers only the time between the 12th of August and the 31st of December, 1904.

COURSE IN FORESTRY AT THE AGRICULTURAL COLLEGE.

The act which establishes this office makes it the duty of the State Forester to give such a course of instruction to the students of the Massachusetts Agricultural College on the art and science of forestry as may be arranged for by the trustees of the college and the forester. I have arranged with the president of the college, Dr. Henry H. Goodell, pending the sanction of the Board of Trustees, for a course of twelve lectures and two field exercises. Several of these lectures will deal with forestry in general; the others will be devoted to the forest problems of Massachusetts, particularly those which arise in connection with farm wood lots, these being the most appropriate for the consideration of agricultural students.

This year (1905) the course will be given in February and March; but hereafter it will probably be given in January, in order that special students taking the short winter course at the college may have an opportunity of getting some instruction in forestry. The college has a small wood lot, for which a plan of management will be prepared, with the assistance of the students. While this wood lot is not a typical one, still, it presents some of the problems that the students are likely to meet with in the management of their own properties.

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* House Document, No. 113, 1905.

PRACTICAL ASSISTANCE TO OWNERS OF WOODLANDS.

Section 2 of the act provides that the State Forester may, upon suitable request, give to any person owning or controlling forest lands aid or advice in the management thereof, the owner being liable to the forester for the necessary expenses for travelling and subsistence incurred by himself or his assistants. Up to the date of this report fourteen applications for practical assistance have been received. These applications represent an area of approximately two thousand acres. Five of these tracts have been visited, and advice has been given in regard to their management. This included the marking of trees for removal, in improvement thinnings, in order to start the owner on the right track. The winter closed in before more work along this line could be accomplished.

While the act gives the forester no authority on State lands, it does make his services available to the State as well as to private owners. Inquiries have been received relative to this matter from the commission in charge of the Mount Tom Reservation, and I hope that other reservations will follow suit; for practical work of this kind on State lands should be the special duty of the State Forester.

In order to make the offer of the State in this matter better known, a circular letter has been printed, setting forth the conditions under which the work may be done, and it is being distributed among those likely to be interested. A copy of this circular is here given. It is hoped that in response to this circular the advice of the forester will be sought more frequently.

In this connection a plan of co-operation between this office and the United States Bureau of Forestry has been arranged. Applications for practical assistance made to the United States Bureau of Forestry by owners of woodlands in Massachusetts will be referred to the State Forester, or such portions of them as he may be able to take care of. The

United States Bureau of Forestry will assist him in the tabulation of data taken in the course of forest work, and he will furnish the Bureau with duplicate copies of such data as may be of value to it. This will mean a considerable saving to the State in the matter of clerk hire. This plan of co-operation was submitted to the Governor by Mr. Gifford Pinchot, chief of the United States Bureau of Forestry, and it received the hearty approval of His Excellency. This kind of co-operation will be of great benefit to both the State and the United States.

[Copy of Circular No. 1.]

Practical Assistance to Owners of Woodlands, including Prospective Plantations.

It is the desire of the State Forester to make the work of his office of as much practical value as possible to the owners of woodlands within the Commonwealth. To this end, as much of his time as other duties will permit is reserved for the owners of woodlands.

Application for practical assistance should be accompanied by a short description of the tract, stating its size, kind of growth, and the distance from city, town or village. Such applications are grouped according to the parts of the Commonwealth from which they come. In this way several wood lots may be examined on the same trip, and the travelling and subsistence expenses of the forester pro-rated among the several owners, making the expenses very light for the individual owner.

As the forester is often in Amherst on official duties, applicants for advice on the management of lands situated in the counties of Berkshire, Franklin, Hampshire and Hampden, are charged travelling expenses from Amherst instead of from Boston, which arrangement makes the services of the forester as available to land owners in the western part of the Commonwealth as to those of the eastern.

In most cases an examination can be quickly made, and advice given verbally; but if upon examination a written scheme of management is found to be advisable, the forester may, with the consent of the owner, prepare such scheme of management or working plan, and he will consult with the owner as often as may be found necessary in carrying out the plan. The expenses connected with the preparation and carrying out of such a plan are to be borne by the owner, as set forth in the agreement between the State Forester and the owner, a copy of which will, upon application, be furnished to any person owning or controlling woodlands in the Commonwealth.

Unforested lands which the owner desires to plant fall within the meaning of the term woodlands, as used above.

A FOREST MAP.

The State Bureau of Statistics of Labor has been in consultation with the forester relative to the collection of forest statistics for the census of 1905, and I am assured that this census will contain more information about the forests of the Commonwealth than any previous census. A map showing the forest area of the State is to be prepared in this connection. Those in charge of this work have shown a commendable spirit in regard to the matter, and I look for some tangible results from this disposition on the part of the Bureau of Statistics of Labor to help along the work of this office.

THE STATE FOREST NURSERY.

It is specified in the act establishing the office that the State Forester may establish and maintain a nursery for the propagation of forest tree seedlings on such lands as the trustees of the Massachusetts Agricultural College may set aside for that purpose on the college grounds at Amherst. The stock raised in this nursery is to be furnished to the State reservations free of charge, and to private owners upon such terms as the forester may fix, subject to the approval of the Governor and Council. I have met a committee of the trustees and have talked the matter over with them, and this committee has recommended to the trustees that a tract of three acres be set aside for the nursery.

My policy in regard to the nursery is to make it a part of the course of instruction at college. It would be a mistake for the State to go into the wholesale raising of seedlings for public distribution, if the nurserymen of this State can be induced to raise forest tree seedlings and sell them at reasonable rates. Heretofore the nurserymen of this State, and in fact most of the nurserymen of the entire country, have been engaged in raising ornamental and shade trees at prices which prohibit their use in forest plantations, and it is likely that the nurserymen of this State will not care to take up a different line of work; in this event, the nursery will be expanded as circumstances may make it advisable. In regard to the collection and distribution of seeds, for which provision is also made in the act, it has been decided to pursue the same policy as in regard to the nursery. Some seed has been collected for use in connection with the nursery, but, as said above relative to the nursery, it would be a mistake for the State to go into the business of collecting and distributing seeds, if reliable men can be induced to undertake it and furnish seeds at reasonable rates.

THE STATE FOREST LIBRARY.

A library of 141 books and pamphlets has been collected, and they are being arranged and catalogued. Nearly all of these are government publications, and have been presented to this office, so that their collection represents almost no expenditure. It will be my policy to add to this collection from time to time, and to make it available not only for office use, but to all who may wish to use it.

EDUCATION OF THE PUBLIC IN FORESTRY.

Section 2 of the act makes it the general duty of the State Forester to promote the perpetuation, extension and proper management of the forest lands of the Commonwealth, both public and private. Under the provisions here implied, twenty invitations, exclusive of the course at the Agricultural College, to talk or lecture on forestry and kindred subjects, have been accepted. It has been necessary to refuse a great many engagements of this sort, for lack of time, although the value of this kind of educational work is fully realized. Eight of these engagements have already been filled, and the others are for this winter and spring.

THE GYPSY AND BROWN-TAIL MOTHS.

The presence in the Commonwealth of the gypsy and brown-tail moths in large and increasing numbers is a serious forest problem. For this reason I have identified myself with the fight against them that has been carried on in the infested districts this fall. I have spoken before a number of public meetings in regard to their suppression; and I am serving the Massachusetts Association for the Suppression of the Gypsy and Brown-tail Moths in the capacity of secretary-treasurer.

RECOMMENDATIONS.

According to section 5 of the act, the State Forester may include such recommendations in his report as he may deem proper. In view of the rapid increase in number and the consequent increase in destructiveness of the gypsy and brown-tail moths, I recommend to the General Court that, in the interest of the preservation of our forests, it take immediate action toward the suppression of the gypsy and brown-tail moths.

It was my intention to have ready some recommendations in regard to legislation looking toward a better protection of our woodlands from fire, and a reasonable relief from excessive taxation; but both these matters need very careful investigation, in order to get the information necessary to frame effective legislation, as the history of legislation in other States along similar lines abundantly proves. At another time some recommendations along these lines will be made. In the mean time, the various phases of the fire and tax problems are being investigated.

RECEIPTS AND EXPENDITURES.

Section 6 of the act appropriates a sum not exceeding $5,000, to be expended annually by the State Forester, with the approval of the Governor and Council, in carrying out the provisions of the act; and requiring that a statement of the receipts and expenditures incident to the administration of his office be made in his annual report. Such a statement follows.

Receipts (August to December, 1904).

Cash to the amount of $8.63 has been returned to this office for travelling and subsistence expenses of the forester, while engaged in practical work for owners of woodlands; and this amount, together with an itemized statement, has been turned over to the Treasurer of the Commonwealth.

Expenditures.

Salaries of assistants,	$260 11
Travelling expenses of forester,	66 43
Forest nursery,	67 10
Instruments and drawing material,	88 85
Stationery and typewriter,	151 28
Postage,	31 50
Library,	13 05
Printing,	7 50
Miscellaneous,	6 54
Total,	$692 36

Respectfully submitted,

ALFRED AKERMAN,
State Forester.

BULLETINS

MASSACHUSETTS BOARD OF AGRICULTURE,

PUBLISHED IN

MASSACHUSETTS CROP REPORTS, 1904.

THE HAY CROP IN MASSACHUSETTS.

BY PROF. WM. P. BROOKS, PROFESSOR OF AGRICULTURE, MASSACHUSETTS AGRICULTURAL COLLEGE.

In Massachusetts the relative importance of the hay crop is much greater than in the United States as a whole. This crop occupies nearly three-fourths of the improved area of our farms. The last State census reports the total improved area in farms as 902,000 acres. The hay crop occupies 660,000 acres. Large as is this proportion, the tremendously preponderating importance of grass as a crop becomes yet more evident when we consider the area devoted to pasturage, which the last State census reports to have been 1,119,000 acres. There is, of course, little doubt that much of this so-called pasture was occupied to a considerable extent with trees, bushes, ferns and numerous other forms of vegetation other than grass. The total annual value of the farm products of Massachusetts, according to the last State census, was $52,880,000. The hay crop is reported by the same census to have been worth $12,491,000. The value of this crop, therefore, amounted to nearly one-fourth of the value of all our agricultural products combined. A large portion of our dairy products is derived from the pastures, and dairy products are reported by the last census to have amounted to $16,234,000, or nearly 31 per cent of the total value of our agricultural products.

The facts to which attention has been called make it perfectly evident that the grass crop is one deserving careful consideration. It occupies an exceedingly large proportion of our total area, and anything which can be done to increase the product will do much to increase the prosperity of our farmers. Great as is the importance of the grass crop at the present time, its relative prominence shows a tendency to increase. This tendency is due in considerable measure to the fact that the production of the grass crop involves relatively little labor; and, in periods of general prosperity especially, it seems to be increasingly difficult for the farmers to secure satisfactory help. Many of them, therefore, are increasing the already large proportion of their farms devoted to grass.

Our numerous cities and villages, while using considerable hay imported from the west and Canada, furnish good markets for the surplus hay crop in most sections of the State. It does not seem probable, therefore, that the relative importance of the grass crop in Massachusetts' agriculture will decrease in the near future.

Our survey of the facts pertaining to the aggregate production and value, while interesting, does not throw light upon the question as to whether the results now attained by our farmers can be regarded as satisfactory. To determine this point we must know not the aggregates but the returns per acre. The last United States census reports the average product of hay per acre in the entire country to be 1.1 tons. The average product in Massachusetts is reported to be exactly the same. Such a product is far below the possibilities, as all good farmers will at once admit. If the average returns from the area devoted to the production of hay in Massachusetts could be increased to the extent of 1 ton per acre, the value of our agricultural products would be raised fully $8,000,000 per annum. Such an increase must mean greatly increased prosperity among our farmers, provided the increase can be produced at a figure materially below its value. That it can be so produced it will be my effort to show in this article.

Argument is not needed to convince the better farmers of the State that this is possible, for few of them are satisfied with crops of less than from 2 to 3 tons per acre, while many of them doubtless make much of their grass land yield annual crops averaging fully 3 tons per acre. Mr. George M. Clark of Higganum, Conn., has in recent years written a great deal concerning the hay crop and methods of increasing it. It may be doubted whether his methods can be in all respects recommended; but thorough tillage of some sort in preparation for grass and careful fertilization are essentials, and Clark's influence and example have been vastly useful in stimulating improvement. He claims to produce from 5 to 6 tons of hay per acre annually in two crops. Under his system of management the profits have doubtless been large. His investment in labor and fertilizers is heavy; but the tremendous crops obtained prove profitable, in spite of the heavy outlay.

Upon the college farm at Amherst we have not upon the average equalled the crops reported by Clark. We have not, however, as a rule, expended more than a small proportion of as much in labor and in fertilizers as he reports. Our profits are perhaps not inferior to those which he has obtained. The area devoted to hay on the college farm averages about 75 acres, and the average product per acre is often equal to 2½ tons. This result is obtained under the following conditions: About 30 acres out of the 75 are kept permanently in grass. Most of this area has not been plowed for about twenty years. It is managed in part as a park, but is mown twice annually. During a great part of the time it has received an annual dressing with fertilizers at an average cost of perhaps $5 per acre. The portion of the college farm managed in rotation is usually left in grass three years, and receives no top-dressing of any kind during the time it is in grass, the crop of grass being produced on the residual fertility remaining after the hoed crops, which usually occupy the ground two or three years out of every five or six years. The average crop on the old mowings amounts to about 2 tons per acre; on the rotation mowings the average must be close to 3 tons.

We possess the most exact records concerning one of the fields of the experiment station. This field has an area of a little more than 9 acres. Most of it was seeded about 1893, and none of it was reseeded until the summer of 1902. Between 1893 and 1902 the average yield for the entire area was 6,619 pounds. In 1902 the average was less, for a part of the land was plowed after the first crop and reseeded in August. This portion of the land, however, gave us in 1903 the heaviest crop we have ever obtained, the average per acre for the entire area for that year amounting to 8,104 pounds. The average yield for the entire period, 1893 to 1903 inclusive, has amounted to almost exactly 6,600 pounds per acre. The average cost of the manure or fertilizer applied to this land annually amounts to about $12 per acre; the annual cost of securing the crop to a little over $8; the annual profit on the crop to about $20 per acre. The figures given, which are verified by the most accurate records, make it sufficiently evident that land of the right character devoted to the production of hay may be made exceedingly profitable. It appears to me evident that the 9 acres under discussion must have an actual value to an intelligent farmer of at least $350 per acre. The average profit, whatever we may hold concerning the value of the land, amounts to more than five per cent annual return on the figure which has been named.

The facts which have been cited make it perfectly evident that the possibilities of the hay crop are vastly beyond the actual results obtained by the average farmer. It may be objected that the land of the college farm at Amherst is especially adapted to grass; that it is better than the average land of the State. Both of these statements are undoubtedly true; but, on the other hand, the value of the hay crop in Amherst is lower than in the average town of the State, and the chances for profit on the crop in most sections must under intelligent management be nearly equal to the chances for profit in Amherst; for the crops to which reference has been made have not been produced by extravagant use of manure or fertilizer, nor under any system of management not practicable for the average farmer of the State. The average mowings of the State are sadly neglected. Their owners practise, at least, as if they expected "out of nothing to get something." Every season whenever rainfall is deficient and the weather hot we read in the crop reports that "grass in the old mowings is suffering, and will be a very short crop." These old mowings are neglected mowings. They have not been manured or fertilized, or they have not been recently reseeded; and it is unreasonable to expect they will give good crops, unless the conditions are unusually favorable.

The character of soil which best suits grass is pretty generally understood. The strong, retentive soils which hold moisture well are the natural grass lands. The production of hay upon these can be made most easily profitable; but by suitable selection of varieties of grasses and clovers, even some of the lighter soils may be made to yield profitable crops. On the other hand, the State contains large areas of low lands which suffer at the present time from excess of water, and which are producing an inferior quality of hay for this reason. In many cases such areas can be converted into very profitable mowings if they be first drained. A considerable portion of the 9-acre field in Amherst to which reference has been made was of this character, and the methods of improvement adopted here will be first discussed.

Drainage of Land to be used for Mowing.

Partial drainage by means of open ditches will in many cases greatly improve the character of the herbage produced in land which is naturally wet, but the only thoroughly satisfactory method of improvement is tile drainage. Many no doubt hesitate to undertake tile drainage through fear of inability to carry out the work properly; others are deterred from undertaking it because of the cost. The limits of this article will not permit a full description of the methods to be followed in underdrainage; but the operation, unless the location is such as to offer unusual difficulties, is not very difficult, and no farmer of ordinary capacity need hesitate to undertake it; and the cost, while considerable, will prove a profitable investment, provided the work is carefully done. Many a tract of land in the State, at present producing a crop of swale hay, and which for the production of such hay is worth possibly $20 to $25 an acre, can at an expenditure of $50 to $60 per acre be made to return a good income on a valuation of from $150 to $200.

Preparation of the Soil for Grass.

The fact that very thorough and careful tillage in preparation for crops of all kinds is usually profitable is increasingly appreciated in recent years; and Mr. Clark must be credited with having done much good in emphasizing the desirability and profitableness of thorough preparation of the soil for grass. When practicable, it seems to be best to plow land which is to be seeded to grass some weeks previous to sowing the seed, and to give sufficient shallow tillage by means of harrows to bring the surface into a thoroughly fine and mellow condition. If seeding is to be done in the spring, it will in most cases be best to plow in the fall, and to complete the preparation in the spring by the use of such harrows as are adapted to the conditions. The disc harrows are very valuable in sod land and in working strawy manures under, but the final preparation should be given by the use of harrows which do not work as deep, and which leave the soil smooth. The Acme harrow is a good implement to follow the disc, while the smoothing harrow is almost always best for the final preparation of the soil for seed. The best condition for the growth of the grass in most soils is obtained by plowing sufficiently long before seeding to permit the soil to settle somewhat, so that when the seed is sown the soil shall be moderately compact underneath, and light and mellow to the depth of a few inches only. When breaking up an old mowing and reseeding without the introduction of a hoed crop, it is best to plow the land as soon as convenient after the first crop of hay is harvested, and then harrow sufficiently often to keep down all weeds and to maintain the surface in mellow condition until the proper time for sowing the seed arrives. In the case of the experiment station mowing, to which reference has already been made and which is referred to again later in this article, the first crop of hay was harvested June 25. The land was plowed on July 16. Between that date and the date of seeding, which was August 14, the land was harrowed with a disc harrow eight times, and final preparation given with the Acme and smoothing harrow just previous to sowing the seed. The crop of the following year, concerning which particulars are given later, was an exceedingly large one. The season of 1903, it is true, was exceptionally favorable for grass, but the very satisfactory results obtained are believed to have been due in no small degree to the very thorough preparatory tillage which the land received.

Whenever seed is sown in soil which is imperfectly prepared, a considerable proportion of it must fail to germinate, and the result is an imperfect sod. There are frequent bare spots, in which weeds will later start; and, even if this were not the case, it would be found impossible to secure the largest crops of which the land is capable unless the surface is completely covered with grass.

THE SELECTION OF THE SEEDS.

For the past dozen years we have grown in the experiment station in Amherst something like 60 or 65 species of grass annually, each occupying a plot of about one square rod. During all this time these species have been under close observation, and records of their yield in some years and of their general condition have been kept. During this time, moreover, a considerable number of different mixtures of grass seeds have been tried on the different fields of the college farm. As a result of the observations on all these species and the trials of different mixtures above referred to, the conclusion has been reached that in ordinary rotation farming, where the land is left in mowing only some three or four years, to be followed by hoed crops for two or three years, there is no mixture of seeds which will prove more widely adapted to the conditions than the usual mixture of timothy, red-top and clovers. It is the belief of the writer, however, that these seeds should be sown in somewhat larger quantities than are usually advised. The necessity for a close turf, covering every inch of the ground, has been referred to. Such turf is more certainly secured with heavy seeding. It is the belief of the writer, further, that the mammoth red clover should usually be used in this mixture rather than the common red clover, as the former matures more nearly at the same time with timothy and red-top. Most of the soils upon the college farm are retentive of moisture, and on these soils some alsike clover is invariably included in the mixture. Alsike is finer than the red and mammoth clovers, and is especially adapted to moist soils. The mixture of seeds which we usually use is as follows: —

	Pounds.
Timothy,	18
Red-top,	8
Mammoth clover,	5
Alsike clover,	4

If a more permanent mowing is desired, it is believed to be best to include other species, for under most conditions timothy does not prove permanent. It gradually gives place to species which are less valuable for hay, — in the eastern part of the State and on the lighter soil in many cases to sweet vernal, farther inland and on the stronger soils to Kentucky blue-grass. The last, although a splendid pasture grass, produces too little top to prove altogether satisfactory in mowings. There is, it is true, no variety of hay which sells so readily in most sections as timothy; but for the reasons stated it seems best to reduce the quantity of timothy, and to introduce species which are more persistent in all cases where the mowing is to be permanent. Among such species the fescues promise to prove the most valuable; and a mixture of seeds in which I have considerable confidence for permanent mowings is as follows: —

	Pounds.
Timothy,	6
Red-top,	8
Red clover,	5
Alsike clover,	4
Kentucky blue-grass,	4
Meadow fescue,	6
Tall fescue,	4

The two mixtures of seeds which have been given were sown on the experiment station grounds in Amherst in the summer of 1902, under conditions which make comparison of the results for the first year possible. The mixture including the larger amount of timothy gave a yield in two crops at the rate of about 5 tons to the acre, while the mixture including the fescues gave a yield at the rate of about 4¼ tons per acre. The timothy mixture is in the first year clearly superior to the other; but it is expected that the fescue mixture will maintain its quality better, since the fescues, which have underground stems similar to those of witch grass, are not likely to be displaced by Kentucky blue-grass to the same extent as the timothy.

On soils which incline to be light, orchard grass proves to be one of the most valuable and persistent grasses, and the following mixture of seeds is recommended: —

	Pounds.
Orchard grass,	15
Tall oat grass,	5
Italian rye grass,	3
Perennial rye grass,	3
Awnless brome grass,	5
Red clover,	6
White clover,	2

The number of seed mixtures, each of which under some circumstances may prove adapted to the situation, might be almost indefinitely extended, but space forbids further discussion of this branch of the subject.

METHODS OF SEEDING.

The three principal methods of seeding land to grass which will be discussed in this article are: first, spring seeding with a nurse crop; second, late summer or fall seeding; third, seeding in corn.

Spring Seeding with a Nurse Crop.

This system of seeding land to grass is, according to the writer's observation, still one of the most common followed by our farmers. It is of course oftentimes attended with satisfactory results. Grass can usually be depended upon to make a good start if sown early in spring with a suitable nurse crop; but it far too frequently happens that when the nurse crop is removed (which must usually be late in June or during the month of July) the exposure of the young grass to the hot sun seriously weakens if it does not destroy a considerable proportion of it. At the season of the year when the nurse crop is removed we have our hottest weather, and not infrequently at the same time a marked deficiency of rainfall. With hot and persistently dry weather following the removal of the nurse crop damage to the young grass is certain to be serious on all except the naturally moist and the richer soils. For the reasons which have been indicated, the writer regards this method of seeding as one of the least desirable.

Late Summer or Fall Seeding.

Grass which is sown in suitably prepared soil during the latter part of summer without a nurse crop seldom fails to do well, and where the system of rotation makes it possible to have the land clear at the right time, or in cases where mowings are to be broken up and immediately reseeded, this seems to the writer to be the best time. In many cases seeding is delayed until the middle of September or later, but if this be the case the clover seed is usually left out to be sown the following spring. With suitable weather in spring clover often makes a good start if sown in this way, but a full crop cannot of course be expected the same season. Better results are obtained if the land can be seeded sufficiently early to make it safe to include the clover with the grass seeds. The reseeding of the mowing in the experiment station, which has been several times referred to, was eminently successful. The clover passed through the winter perfectly, and constituted a large proportion of the crop of hay produced. The month of August is, in the writer's opinion, the best month for seeding to mixed grass and clover; and the most satisfactory results are likely to be obtained if the seed can be got in not later than about the middle of that month.

Seeding in Corn.

Among the various methods which the writer has tried for seeding to grass and clover, he has found the system of sowing in growing corn at the time of the last cultivation, usually from July 20 to August 5, to give most satisfactory results. The culture of the corn must be level, and it must be kept free from weeds. Just previous to sowing the seed a spike-tooth cultivator should be used, which will leave the surface fine and mellow. The quantity of seed used should be rather larger than may be required when it is sown alone, as a part of it fails to reach the ground, being caught and retained by the broad leaves of the corn. Dog-day weather should be selected for sowing the seed; and if it can be scattered upon the freshly cultivated surface just before the heavy showers which occur so frequently during dog-days, the seed will need no covering, and will often have germinated within forty-eight hours from the time of sowing. The shade of the corn crop is favorable to the retention of moisture, and on all except the driest soils there will be moisture enough to keep the young plants growing. The corn protects from the sun, but does not crowd. It is not likely to lodge and stifle the young grass, as a crop of small grain so often does. It is preferable that the seeding be done in a crop of corn destined for the silo. This being carried from the field at once, the grass has the most favorable time of the year to spread and gather strength for the winter. If the corn is grown for grain and must be stooked, there is no great difficulty; but the young plants will be killed where the stooks stand, and these spots must be reseeded either late in autumn or early the following spring. Grass and clover sown in accordance with the method just described become fully established before winter, and are less liable to injury than when sown later. They become sufficiently strong to give a full crop the following year. It is best that the corn be cut low, and the field should be rolled the following spring as soon as it becomes sufficiently firm not to be cut up by horses. Rolling at that time breaks down the corn stubble, which is then brittle, and it will be noticed in the hay to a less extent even than is the stubble of a small grain.*

When land is seeded in corn, the work must be done by hand; but if the field be clear, there are a number of machines which will do satisfactory work. Machines of the type of Cahoon's broadcast seed sower will put in any of the seed mixtures which have been given. One objection to machines of this class is the fact that the seed is thrown high into the air, so that satisfactory work can be done only when the weather is relatively calm. The wheelbarrow seed sowers will do somewhat more even and satisfactory work, but these will handle only the relatively small and heavy seeds; the long or chaffy seeds cannot be satisfactorily distributed by the use of these machines. A mixture of timothy, red-top and clovers can be sown with a machine of this type in a thoroughly satisfactory manner.

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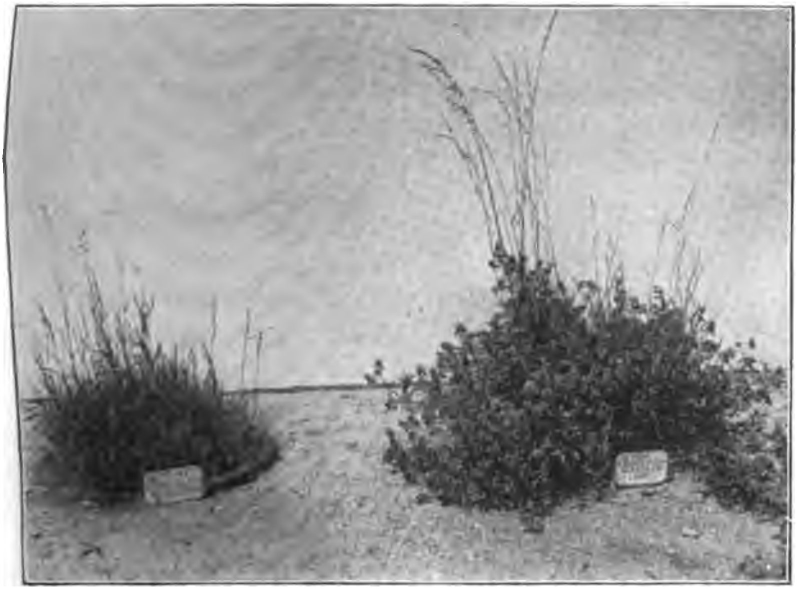
* Brooks's Agriculture, Vol. II., p. 426.

MANURING GRASS LANDS.

The question of the proper selection and use of manures and fertilizers for grass lands may be best considered under two general heads: first, manuring in preparation for the crop; second, top-dressing.

Manuring in Preparation for the Crop.

It seems best at the outset under this topic to state as briefly as may be possible some of the facts which seem to be best established as regards the general effects of manures and fertilizers. Some of these facts are equally important in considering the selection of manures and fertilizers for top-dressing. Our mowings almost always contain two classes of plants, — grasses and clovers. The manurial requirements of these two classes of plants are, in one important respect, wholly different. Both grasses and clovers require a considerable amount of nitrogen, clovers more than grasses; but the grasses must take all the nitrogen which they require from the soil, while the clovers, if conditions be right, can get most if not all of the nitrogen they require from the air. Whenever land is occupied by two or more species of plants, there is a struggle between the different kinds for its possession. If we make the conditions favorable to clovers and less favorable for grasses, the former will predominate. Whether the mowing will produce chiefly grasses or largely clover, depends, then, not alone upon the seed sown, but upon the condition of the soil as regards available nitrogen and available mineral elements of plant food, such as phosphoric acid, potash and lime. If available nitrogen is relatively abundant, then grasses will predominate; if the other elements are relatively abundant, while nitrogen is present only in small amounts, the clovers are likely to predominate. If this is to be the case, however, it is important that all the other conditions required by clover shall be right. Good drainage, thorough tillage and freedom from free acid are essential. From many parts of the State come reports that clover does not thrive. This in many cases is doubtless due to the fact that the soil contains free acid. Under such circumstances a heavy application of lime spread on the rough furrow and deeply worked in with a disc harrow will be likely to prove effective. The cut which is here presented shows the effect of liming in a striking manner. Both cylinders were filled with carefully mixed soil, taken from one of the fields of the college farm. Both received an application of the same amounts of nitrate of soda, dissolved bone-black and muriate of potash, and in addition one cylinder received an application of lime at the rate of 1 ton per acre. After the application of the fertilizers and the lime, the same kinds and quantities of mixed grass and clover seeds were sown. The result is a most striking demonstration of the efficacy of lime in bringing a sour soil into condition for the production of clover.



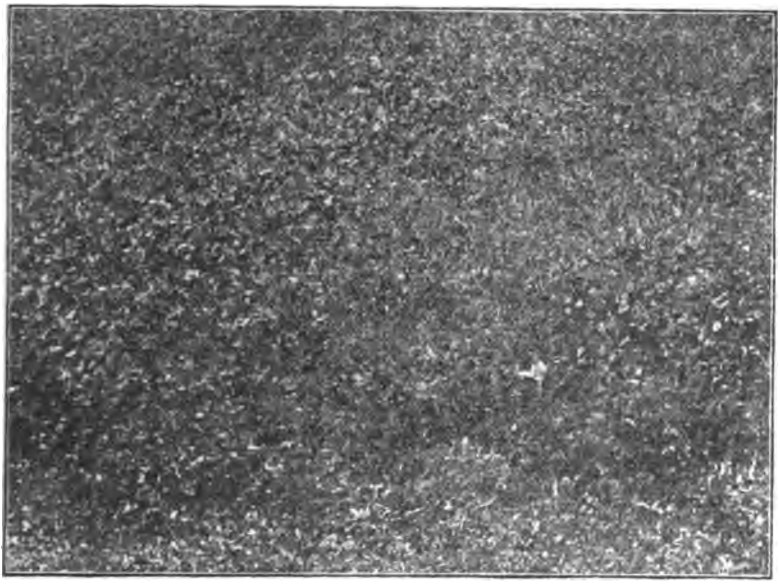
EFFECT OF LIME ON PROPORTION OF CLOVER.

In order that the clover may have the capacity to take the nitrogen it needs from the air, it must have the assistance of the bacteria which live in nodules (which are about as large as the head of a pin) on its roots. These bacteria can be supplied either by the application of a few hundred pounds per acre of soil from a field where the nodules are found to be abundant on the clover, or by the use of a special culture prepared in the United States Department of Agriculture. It is not believed, however, that it will often be found essential to supply these bacteria. Clover has been so long and so generally grown in this section, that these bacteria are practically everywhere abundant; and the nodules will develop upon the roots of clover in practically all situations, provided the conditions essential to the life and activity of the bacteria (which are, in brief, good drainage, thorough tillage and aeration and freedom from free acid) exist. The supply of nitrogen in the air which the clover bacteria under the right conditions bring within the reach of the crop is practically unlimited. It pays, therefore, to make the supply of the elements which clover must take from the soil exceedingly abundant, and among the elements needed potash is one of the most important. In preparation for clover, it is believed that the application of from 200 to 300 pounds of a high-grade potash salt, or double that quantity of the low-grade sulfate of potash, will in most cases be useful.

If manure is carefully saved and applied in moderate amounts, clover often does well; but if any considerable proportion of the urine of the manure has been suffered to waste, or if the manure has been exposed to the leaching action of rainfall, there will be a deficiency of potash, which is found chiefly in the urine, and which, being soluble, is easily washed out. If, then, it be desired to bring land on which manure has been used for previous crops into good condition for producing a hay crop rich in clover, it will usually be best to supplement the manure by means of an application of potash. From 125 to 150 pounds of a high-grade potash salt per acre, applied in connection with manure to the previous crop, will almost invariably largely increase the proportion of clover in the hay crop when the land is seeded.

If fertilizers alone are used for the preceding hoed crops, these must be rich in potash if clover is to thrive when the land is seeded.

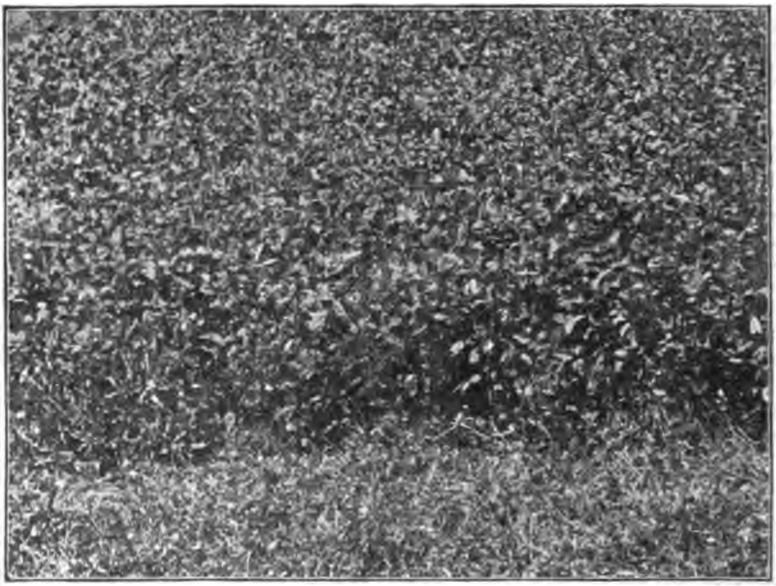
Upon the college farm at Amherst we have for about thirteen years applied potash to two plots of one-quarter acre each at the rate of about 250 pounds per acre of a high-grade potash salt. To two other plots the same salt has been applied at the rate of about 150 pounds per acre. When this land is seeded, the hay crop where the larger amount of potash is used is considerably larger and contains a much greater proportion of clover than where the smaller quantity of potash is used. In 1902 the larger application of potash gave a yield at the rate of 6,772 pounds per acre; the smaller application of potash yielded at the rate of 5,252 pounds per acre. For a full understanding of the conditions in this experiment, it should be further stated that the quantity of nitrogen applied to the two sets of plots is substantially the same, while the plots receiving the lighter application of potash annually receive an application of acid phosphate at the rate of about 1,100 pounds per acre,



Clover on Muriate of Potash makes a Poor Growth.

and the plots receiving the larger amount of potash receive acid phosphate at the rate of about 200 pounds per acre. The fertilizer applied where the lesser amount of potash is used is substantially the same in its composition as average corn fertilizers; while the other, as will have been noted, contains far less phosphoric acid and much more potash.

The kind of potash salt to be selected for clover is a matter of much importance, and experimental results at Amherst have indicated again and again that the sulfate is likely to prove decidedly superior to muriate or to kainit. The cuts presented herewith illustrate the difference in the growth of clovers on the two salts in a striking manner. These two plots were side by side, and both had been manured with equal quantities of fine-ground bone and potash for some eight or ten years. The growth on the sulfate of potash, it will at once be seen, is most decidedly superior to the growth on the muriate. The persistent use of the latter, as indicated by the investigations of Dr. Goessmann, appears



CLOVER ON SULFATE OF POTASH MAKES A FINE GROWTH.

to cause the loss through leaching of a large amount of lime, and it is perhaps this effect which makes it impossible for the clover to thrive. The difference in the growth of clover on these two salts of potash is invariably greater in relatively wet than in dry seasons.

Conditions affecting the Growth of Timothy and Red-top. — Whenever the soil is abundantly supplied with manure or fertilizers which supply nitrogen in relatively large amounts, timothy will be found relatively abundant in the mowing, unless the soil be sour. If it be sour, the red-top will predominate, while, as already stated, there will be little or no clover. If, then, it be desired to produce first-class timothy hay for sale, the farmer should make sure that his soil is not sour; and if found to be so, he must apply lime, as already advised for clover. On soils which are not sour, heavy applications of barnyard manure bring the land into good condition for timothy; and if it be desired to produce market hay, it will usually be best not to use potash largely in connection with the manure for the crops preceding the grass. For market hay, heavy applications of nitrogen manures or fertilizers and relatively light applications of materials containing either potash or phosphoric acid should be the rule.

Top-dressing Grass Lands.

Throughout the State manure is quite largely used for top-dressing grass lands, and every good farmer knows that fine crops of hay can be produced through its use. It may be doubted, however, whether the manure on many of our farms might not be more advantageously used in most cases upon the plowed lands. The elements of value contained in the manure are most certainly conserved for the use of the following crop when the manure can be incorporated with the soil. When it must lie upon the surface, it is subject to some loss, chiefly in two ways: first, by the escape of ammonia into the air; and second, by wash over the surface. Further, the manure, unless fine, tends to kill the grass to some extent. The necessity for a close turf for the production of maximum hay crops has been alluded to. If numerous little areas are prevented from full development because covered by lumps of manure, the result must be a not unimportant decrease in the crop. For all these reasons, it is the belief of the writer that under average farm conditions manures should be mainly used on the plowed land, and fertilizers depended upon for top-dressing grass lands. Whenever manure is chiefly depended upon for top-dressing, the grasses will be found to be relatively prominent, for manure is relatively rich in nitrogen. The use of manure, therefore, is likely to lead to the production of a good grade of hay for market. Manure, if to be used for top-dressing, should be at least partially rotted. It is best to put on in the fall, and a manure spreader is a very desirable implement for the work.

The selection of fertilizers for top-dressing grass lands must be determined largely by the character of hay which it is desired to produce, and it should also be varied according as the mowing is permanent or used in rotation for hoed crops. On mowings which are used in rotation for hoed crops, and where the production of market hay is the object, nitrate of soda should be the most prominent among the fertilizers used; and, while the quantities which it will pay to apply must of course vary with the conditions. the following mixture is suggested: —

	Pounds.
Nitrate of soda, ...	175 to 200
Acid phosphate, ...	50 to 100
High-grade sulfate of potash, ...	50 to 100

These materials should be mixed and applied about May 1. For similar mowings, where a large proportion of clover in the hay is desired, the following mixture of materials is suggested: —

	Pounds.
Acid phosphate, ...	100
Basic slag meal, ...	400
High-grade sulfate of potash, ...	150 to 200

These materials should be mixed and applied either late in the fall or very early in the spring.

For permanent mowings, as well as for those used in rotation, nitrate of soda should be prominent if the production of market hay is the object. The quantity of this fertilizer which may be used must be determined largely by experience. An application which may be safely used on some soils or in some localities will cause the grass to lodge seriously in others. The usual range in quantity which may be profitably used is from about 150 to 250 pounds per acre. The following mixture of materials, although not yet tested for a long period of time on the college grounds at Amherst, is recommended with much confidence: —

	Pounds.
Nitrate of soda,	150 to 250
Basic slag meal,	300 to 400
High-grade sulfate of potash,	75 to 100

For the permanent mowings, where hay rich in clover is desired, an annual application of basic slag meal, 400 to 600 pounds, and high-grade sulfate of potash, 125 to 200 pounds, will, it is believed, give good crops. The mixture of materials containing nitrate of soda should be put on about May 1, the other mixture late in the fall or early in spring.

It will be readily understood that the mixtures suggested by no means exhaust the possibilities, and they may not under all conditions prove the most desirable. Thus, for example, wood ashes may in many localities give the most profitable returns when used on mowings in which clover is desired. These may take the place of the slag meal and potash mixtures which have been suggested. The ashes will supply a large amount of lime, as well as potash and phosphoric acid. Fine-ground bone is also under many conditions a useful fertilizer, especially in mixture with potash, for permanent mowings where clover is desired. The experiment station plots have been several times referred to. The 9-acre field is divided into three nearly equal plots. Each of these is treated as follows: first year, barnyard manure at the rate of 16,000 pounds per acre, applied in the fall; second year, wood ashes at the rate of 1 ton per acre, applied in early spring; third year, fine-ground bone 400 pounds per acre and muriate of potash 200 pounds, mixed and applied in early spring. Each year all three systems of manuring are represented. Our average crops under this system have been heavy, having amounted, as has already been stated, to 6,600 pounds per acre.

Reseeding Permanent Mowings.

That it pays occasionally to reseed permanent mowings is made very evident by the results obtained in Amherst in the season of 1903. A portion of each of two plots in the station mowings was plowed and reseeded in the summer of 1902, as already described. One of these plots was the one top-dressed in 1903 with wood ashes. The yield on the portion not reseeded was at the rate of 6,243 pounds per acre; on the reseeded portion the yield was at the rate of 8,546 pounds. On the plot manured with barnyard manure the yield on the portion not reseeded was at the rate of 5,642 pounds per acre; on the reseeded portion it was at the rate of 10,002 pounds per acre. The manure used on the reseeded portion of this plot was harrowed in at the time the seed was sown; the balance of the plot was top-dressed late in the fall, as usual.

Top-dressing for Rowen.

Experiments extending over several years in Amherst indicate a probable profit from the application of a moderate top-dressing of nitrate of soda immediately after the removal of the first crop. This should of course be made only on mowings where the product is almost exclusively grasses. Top-dressing with nitrate of soda for clover would be a mistake, as this, as already stated, should get its nitrogen from the air. The quantity of nitrate likely to prove useful will usually vary between about 150 and 200 pounds per acre.

THE GROWING OF MUSHROOMS.

BY DR. GEO. E. STONE, PROFESSOR OF BOTANY, MASSACHUSETTS AGRICULTURAL COLLEGE.

During the past decade considerable increased interest has been manifested in edible mushrooms of all kinds. Numerous publications, some of which are extensive and profusely illustrated volumes, have made their appearance, and in recent years mycological societies have been established in many localities. The members of these societies are enthusiastic in studying mushrooms, and, as a consequence of a large amount of diligent study, together with the testing of various types of edible species, a vast amount of information has been secured on this subject.

There is also an increased interest pertaining to the growing of mushrooms for the market, especially existing among amateurs and those who wish to indulge in some form of gardening on a small scale.

It is the purpose of this article to present in a brief manner an account of mushroom growing.

WHAT MUSHROOMS ARE.

Mushrooms are low, humble plants, belonging to the large group collectively known as fungi. Fungi are white plants, and are not infrequently called colorless, since they contain no green coloring matter, such as is characteristic of leaves. On account of the absence of green coloring matter, or chlorophyll, they are incapable of decomposing the carbon dioxide of the air and building up compounds of starch, sugar, etc., which constitutes one of the chief characteristics of green plants.

Mushrooms are what botanists term "saprophytes," that is, they obtain their food from decomposed organic matter contained in the soil. They do not propagate by seeds, as the higher plants do, but have instead numerous microscopic spores, which possess a similar function to seeds, but are much more simple in their make-up. On this account mushroom spores do not possess the same chance for reproduction of the individual as seeds, hence the necessity for spores to be reproduced in enormous quantities, in order that a few may be fortunate enough to alight in some favorable situation suitable for germination and the reproduction of the individual. The spores are borne on the so-called gills, located under the head, or umbrella-like shaped cap, which is termed technically the pileus. The mushroom that is gathered for market constitutes the fruiting portion of the plant. The other portion of the plant is comparatively insignificant, and is represented by the white thread-like growth, or mycelium, which permeates the soil.

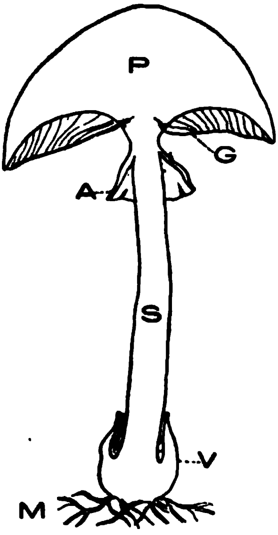


FIG. 1.—Longitudinal section of a mushroom; poisonous species of amanita. *P*, pileus; *G*, gills or lamellæ, on which the spores are borne; *S*, stipe or stem; *A*, annulus or ring; *V*, volva; *M*, mycelium.

The so-called mushroom spawn is composed of these threads or root-like filaments, composted with manure and pressed into bricks. Much of the spawn or bricks sold in the markets comes from England or France, and frequently fails to spawn when planted under favorable conditions. The English spawn is sold in the form of bricks which weigh about one and one-fourth pounds, while the French spawn is composed of flakes or loose material. Spawn is sold by all of the leading seedsmen. In sowing the spawn the bricks are broken up into numerous small pieces and planted. The larger the amount of live spawn contained in the bricks, the better is the product. Occasionally attempts have been made to utilize home-made spawn, but practically all of this material used is imported.

Mushrooms do not constitute an especially easy crop to grow, or, at least, success has not always been obtained by those who have attempted to grow them. One of the chief difficulties appears to lie in poor spawn, and undoubtedly proper temperature and soil conditions have not always been maintained.

During the past two years the Bureau of Plant Industry at Washington has attempted to improve the quality of spawn and methods of growing mushrooms. It is anticipated that the results of this work will appear subsequently in a special publication, and it is expected that much valuable information resulting from research upon this subject will be available, and will materially assist mushroom growers in their business.

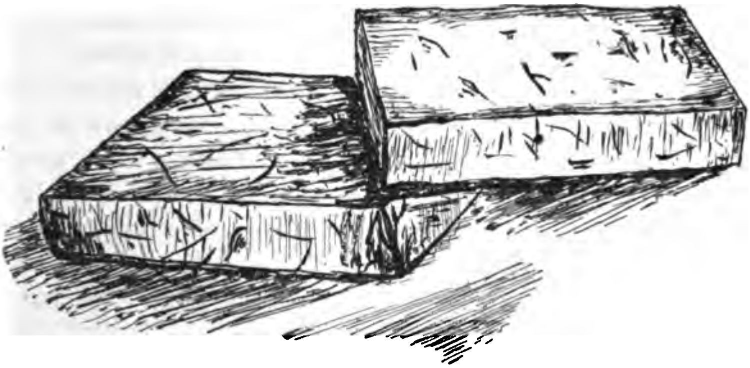


FIG. 2.—Spawn mixed with manure and pressed into bricks.

How Mushrooms are grown.

The common mushroom of the market (*Agaricus campestris*) grows almost everywhere out of doors. It is readily detected by those familiar with mushrooms, and especially by foreigners who have spent their early life in Europe, where considerable more attention is given to edible fungi than in America. It is a matter of common observation in summer to see Italians gathering various edible mushrooms in pastures. Mushrooms frequently come up by themselves in greenhouses under the benches where manure and potted soil is stored. We have gathered frequently many specimens thriving in such localities. When mushrooms are grown for the market on a commercial basis, it is essential that all of the conditions be made as desirable as possible for their growth and development, in order that a large and profitable crop may be obtained. It is necessary that a uniform degree of temperature be maintained, and that the crops be secluded from drafts and sunshine. Total darkness, however, is not absolutely necessary, since mushrooms grow well in diffuse light. Uniform temperature and moisture conditions are more likely to exist in dark places, and it is for this reason that mushrooms are grown in the dark. Those who grow mushrooms commercially make use of cellars, barns, sheds, tunnels and space under greenhouse benches, etc., as well as in specially constructed mushroom houses. It is desirable, however, to have a tolerably dry foundation for a mushroom bed. The conditions of a cellar can be made suitable for mushroom growing, especially for amateurs who wish to go into the business on a small scale. By partitioning off a portion of the cellar and closing up the windows more constant and uniform conditions can be obtained. Space under greenhouse benches can be made especially suited to mushroom culture, and many growers take advantage of this space for their propagation.

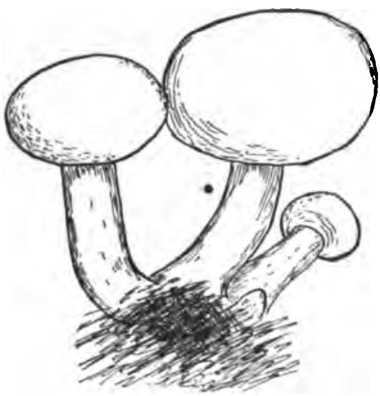


FIG. 3. — A group of mushrooms (*Agaricus campestris*).

CONDITIONS ADAPTED TO MUSHROOM GROWING.

Soil. — The most suitable soil conditions for mushroom culture consist in supplying the beds with plenty of good horse manure, mixed with loam or decomposed sod, mixing about one-fourth or one-fifth loam or decomposed sod with manure. Either fresh or partially rotted manure can be used, and this should repeatedly be well worked over, composted and watered frequently, taking care that it does not burn. After it has been well worked over and composted various times, and the heat is not likely to rise above 130° F., it should be thoroughly incorporated with one-fourth to one-fifth decomposed loam or sod. It can remain in this condition until ready for use. The beds are usually made up ten to fourteen inches deep, and in these are placed the soil and manure for growing them. The bottom of the bed should be supplied with six inches of fresh manure, well tamped down. It should be covered with the prepared manure and loam mentioned above, adding about two inches at a time, and compacting the same. If it shows a tendency to heat too much, incorporate a little loam with it. One or two layers two inches deep of the prepared loam and manure can be put on each day until the required depth is obtained. Straw or some mulching material is then put over the top of the bed until ready to spawn. This answers the purpose of catching the condensed steam and keeping the surface from getting too wet. After the temperature of the beds has reached about 90° to 95° F., the straw should be removed and the bed spawned, although some growers prefer a temperature of about 80° F. This is accomplished by breaking the bricks into pieces, and planting the pieces in rows in the bed. The rows should be about one foot apart, and the pieces of spawn inserted every six or eight inches,

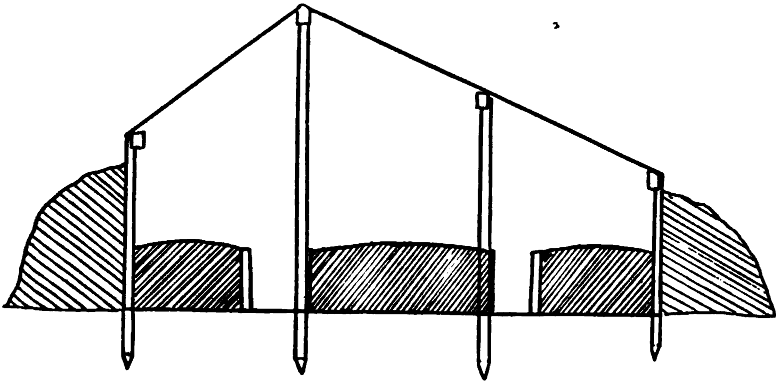


FIG. 4.— Cross-section of a wooden mushroom house, about sixteen feet wide, provided with beds. The house is banked up with earth, and the earth is covered with salt marsh hay, heated from boiler.

and covered up superficially with the soil. When spawning is completed, compact the surface of the bed all over. After this is accomplished, the bed can again be covered with straw, and in the course of eight or nine days the straw is removed and the bed covered with two inches of good, mellow loam. Care should be taken that the temperature of the bed does not exceed 80° F. after covering, as in that case one is likely to lose the crop.

Temperature and Moisture. — Before the mushrooms have made their appearance through the loam, a temperature of from 65° to 75° F. may be obtained; but after the mushrooms have commenced to develop, the temperature should be kept about 55° F. If the temperature goes above 60° F., some means should be employed to lower it; and if it goes below 50° F., it should be raised either by covering the beds or by applying artificial heat. Beds should never be allowed to become too dry, and must be kept tolerably moist, either by employing matting or old carpets before the mushrooms appear, or by sprinkling with water.

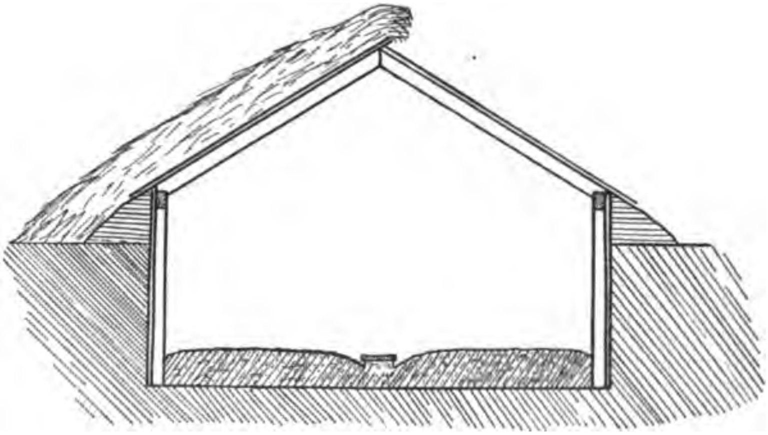


FIG. 5. — Cross-section of a mushroom house. The house is constructed of wood and banked up with earth, and the earth covered with hay or straw.

Houses. —Where special attention is given to commercial mushroom growing, houses are constructed which are adapted to the growth of this crop. The style of houses shown in Figs. 4 and 5 represents types that have been utilized for some time by various commercial growers of mushrooms. The houses usually set two or three feet below the level of the ground, and dirt is piled up on either side to the level of the plates which support the roof. These types of houses have usually been built of wood, and the roof is covered with hay or marsh grass. The beds are either built on the ground, or slightly raised. In the latter case they are provided with board sides, thus leaving room for a path, as shown in Fig. 4. Some improvement has been made in recent years in the style of houses for mushroom culture. One of the principal objections to houses such as shown in Figs. 4 and 5 is that they are very likely to rot out quickly, and it is expensive to renew them. An experienced mushroom grower informed me that such a house would only last about three years. On account of the dampness arising from the heat of the manure, and the unfavorable situation of material constructed of wood, rotting occurs very quickly. The conditions in a mushroom house are exceedingly favorable for timber-destroying fungi, thus causing premature decay. The house shown in Fig. 6 is a more recent model, used by Wyman Brothers, market gardeners, Arlington, Mass. It is an even-span house, fifteen feet wide, and about four feet high at the sides. The length of such a house is of course immaterial. The

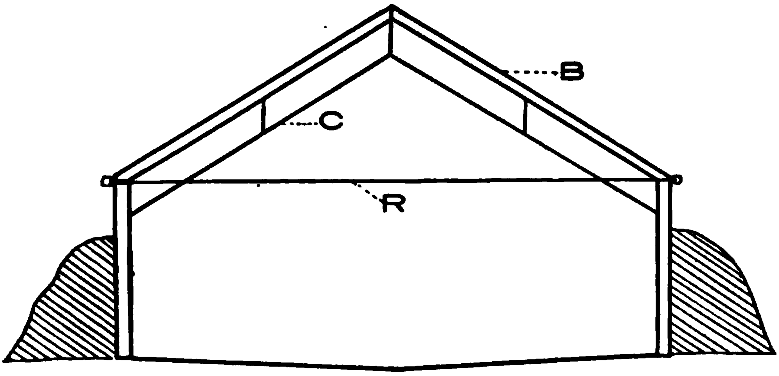


FIG. 6.—Cross-section of a cement and corrugated-iron mushroom house, banked up with earth. The house is provided with a truss roof. *C*, corrugated iron; *B*, wooden truss; *R*, half-inch iron tie rod. The house is fifteen feet wide and four feet high at ends to iron roof, and is heated from boiler.

side walls are built of cement, and there is a truss roof constructed out of wood and corrugated iron. The corrugated-iron roof and cement sides furnish construction material which will not readily decay; and, while a house of this description may cost more at the outset, it is far cheaper in the end for a commercial grower who intends to follow that line of work. Cellar benches can be constructed singly or in series, one or more above the ground bed. A single bed is shown in Fig. 7. The construction of cellar beds would depend materially upon the space and the conditions available.

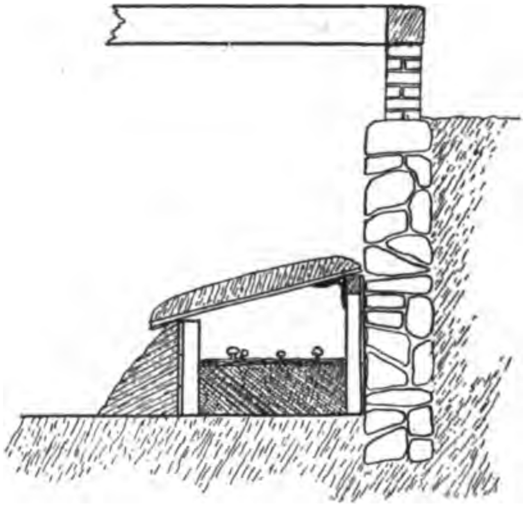


FIG. 7. — Section of a cellar bed covered with boards and matting and banked up with earth.

GATHERING THE CROP.

It is necessary with a crop like mushrooms, as it is with many others, to go over the beds each day and gather the mature specimens. These are gathered in trays, care being taken not to have them become soiled in handling.

In picking mushrooms, it is recommended that they should not be cut off at the base, but gently twisted and removed from the soil. When it is necessary to cut, as is sometimes the case when they come up in large numbers, it is recommended that the butts be subsequently removed and the holes filled with soil, in order to prevent decay. Mushrooms can be kept in a cool, dark place for two or three days after picking, with little detriment.

Price of Mushrooms.

Mushrooms, like other crops, are usually assorted into grades, which bring different prices. The price of mushrooms usually varies from one season to another, and also during the same season. A No. 1 product will bring $1 per pound during certain seasons, while at other seasons it will sell from 25 cents to 50 cents per pound. During the past winter mushrooms were as low as 25 cents per pound at one time in the Boston market.

Diseases of Mushrooms.

There are a few troubles caused by fungi, insects, etc., which occasionally give rise to loss of mushrooms. Among some of the troubles experienced, the following may be mentioned. Dark-colored spots coming on the cap of the mushroom, which induce decay and render them unfit for the market. These are caused by eel worms, which are minute microscopic worms similar to those frequently giving trouble to tomatoes, cucumbers and various other plants. Various animals, such as maggots, wood lice and sow bugs, occasionally give rise to trouble, and there are certain rots caused by fungous growths which sometimes damage the crop.

On account of very little attention having been given to the diseases of mushrooms, no definite specific remedies have been suggested for many of these troubles. No doubt there are, however, cultural methods which could be applied, that would prove of some value in exterminating or controlling the ravages of these various organisms.

HARVESTING AND MARKETING APPLES.

BY F. A. WAUGH, PROFESSOR OF HORTICULTURE, MASSACHUSETTS AGRICULTURAL COLLEGE.

The apple tree is peculiarly at home in Massachusetts and New York State. Northward the severe winters make the growing of many varieties precarious, while southward the trees are less and less thrifty, until in the extreme southern States apples are almost as rare as oranges are with us.

The commercial importance of the apple crop in Massachusetts is increasing rapidly from year to year. In general, we are seeing more clearly that the more refined lines of agriculture are the ones in which we reap the greatest success; and amongst these fancier crops, requiring more intensive culture, the apple takes high rank.

It must be said that the methods of handling the apple crop have been very much changed in recent years. The farmers who still adhere to the old-fashioned way of doing things do not find great encouragement in selling apples; on the other hand, those who have taken up with modern ideas, or, better still, have led in the establishment of modern practices, are reaping their just and generous reward.

Picking the Fruit.

The time was when the apples used to be shaken off the trees; a still lazier method was to allow them to fall off. Such apples are fit only for second-class cider, and if that was the market to which they were destined, no great damage was done. However, such apples are still sometimes offered in the markets. They are almost always a dead loss to the man who attempts to sell them, and interfere, sometimes seriously, with the sales of good, hand-picked fruit. Apples must be hand-picked from the trees in order to be marketable, — this is the only way. Moreover, they must be carefully hand-picked, and they should be taken off with the stems attached to the fruit. If the apples are torn off the stems, the skin is ruptured, and decay is apt to set in.

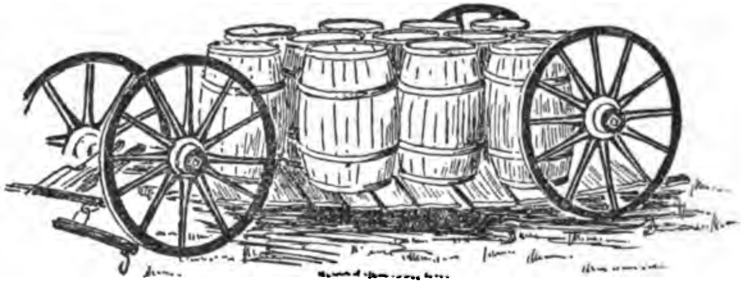
The best receptacle in which to pick apples is the oak splint, swinging bale, half-bushel basket. If fancy fruit is to be handled, it is worth while to pad these baskets with old grain sacks. A heavy wire, bent in the form of the letter S, enables the picker to hang the basket on a limb while it is being filled, and also to let it down by a strap out of the tree.

PICKING BASKET, — OAK SPLINTS, ONE-HALF BUSHEL, SWINGING BALE.

Picking ladders are usually needed on old trees. These should be long, and as light as possible. Step-ladders are sometimes used; they should always be of the three-legged variety.

Certain varieties of apples, as, for example, Wealthy, have the bad habit of falling early from the trees. With such varieties picking has to be timed with reference to this bad habit. Fruit must be picked early enough to prevent its falling. Other varieties which hold on well, like Baldwin and Spy, may be picked when they are at their best. There has been a good deal of argument as to just when an apple should be picked, but recent experiments show that apples which are ripe and fully colored keep better in storage than those which are picked earlier.

This matter of having apples fully grown, ripe and thoroughly colored is of so much importance that some growers who make a specialty of fancy fruit have adopted the practice of picking over the tree two or three times. Those apples which are mature and colored are taken off at each picking, while those which are yet green are left. These green apples increase in size rapidly, and take on the proper color eventually. The men who have tried this method say that it pays well.


HOME-MADE FRUIT WAGON FOR HANDLING BARRELS.

In handling the fruit in the orchard, between the trees and the storage room, or, later, between the storage and the shipping station, some suitable wagon ought to be provided. A stone boat is sometimes used, and is not the worst thing that could be found, especially for short hauls and small loads. It is better, however, to have one of the low-down wagons, made especially for handling fruit. In the illustration one is shown as it was actually made up at home. Some sills were hung by strap irons from the front and rear axles of a common wagon frame, and on these some boards were laid, making a floor for carrying the barrels. Handling barrels of apples in and out of the common high wagon is hard and expensive labor, and it is apt to damage the fruit.

GRADING THE FRUIT.

In nothing does the work of the experienced apple seller differ more from that of the inexperienced man than in the grading of the fruit. All of our city markets have now reached a point where fruit can hardly be sold at any price unless it is carefully and uniformly graded and properly marked.

Apples should be graded into at least three lots, which we may call firsts, seconds and culls. Sometimes four grades are made, but the three here mentioned are the most usual. The first grade of fruit must be of good size, uniform in shape and color, free from blemishes and true to name. Second-grade fruit is smaller, not so well colored, but must be free from any serious blemishes. The National Apple Shippers' Association has adopted a rule for determining first and second grade apples as follows: —

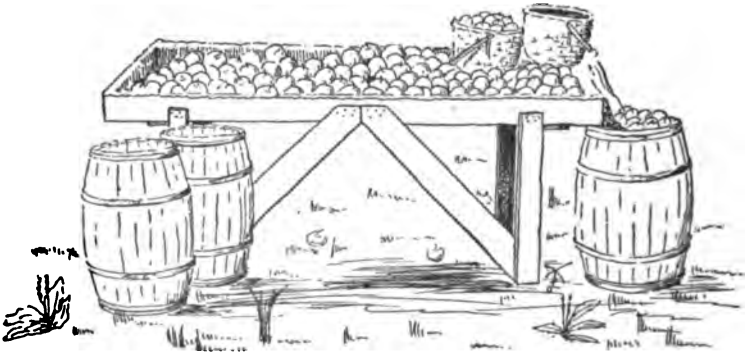
> The standard for size for No. 1 apples shall be not less than two and one-half inches in diameter, and shall include such varieties as Ben Davis, Wealthy, Twenty-ounce, Baldwin, Greening and other varieties kindred in size. The standard for such varieties as Romanite, Russet, Winesap, Jonathan, Missouri Pippin and other varieties kindred in size shall not be less than two and one-quarter inches; and, further, No. 1 apples shall be at the time of picking practically free from the action of worms, defacement of surface or broken skin. They shall be hand-picked from the tree, a bright and normal color, and shapely in form. No. 2 apples shall be hand-picked from the tree; shall not be smaller than two and one-quarter inches in diameter; the skin must not be broken or the apple bruised. This class must be faced and packed with as much care as No. 1 fruit.

The different grades are variously designated, sometimes as fancy, choice, select, prime, XXX, XX, etc., but these designations have no official standing. There is so much variation in the practice of packing that none of these marks has any distinctive meaning.

In grading and packing apples a sorting table should be built, somewhat in the form as shown in the illustration. It should be large enough to hold at least three barrels of apples spread out at one time. At one end there should be an opening or spout heavily padded with gunny sacks. Through this opening apples may be guided and gently rolled into barrels. Some sorters prefer, however, to sort into baskets. The baskets are then emptied into barrels.

Considerable experience and natural good judgment are required to sort apples rapidly and accurately. The task is difficult, and highly important; the man assigned to it should be the best on the job.

In filling apple barrels, the work begins at what is really the top of the barrel. The head is put in and the barrel turned bottom side up on it. The first layer of fruit is put in by facing, stem downward, carefully on this inverted head. Good, well-colored specimens are selected as facers, but they should not give a misleading idea of the general contents of the barrel. Usually a second row of facers is put in, stems down, in the same way. The remainder of the barrel is filled in with loose apples. These are thoroughly shaken down three or four times during the process of filling. Finally the barrel is sometimes finished by facing the last row in the bottom (that is on top as the barrel is filled). When the filling is complete, the barrel should be somewhat more than full. The fruit should stand up



SORTING TABLE.

two or three inches above the chines. This amount will be taken up in pressing the head or the bottom in place. The bottom is pressed in with a screw or lever press, is nailed in place, and the barrel is ready for the market.

APPLE BARRELS.

Customarily, the package for selling apples is the barrel. There are various forms of barrels in use in this country, the two most common ones being the hundred-quart barrel and the ninety-six-quart barrel. The National Apple Shippers' Association have adopted the barrel having the following dimensions: stave, 28½ inches; head, 17¼ inches; circumference in the middle, 64 inches. This is the hundred-quart barrel. There seems to be a tendency at the present time to use more of the ninety-six-quart barrels.

The barrel market, however, in the last few years has been a very difficult and unsatisfactory one. The prices have been abnormally high, and promise to be higher than ever this season. It seems probable now that good barrels cannot be had anywhere for less than 40 cents each. Under these circumstances many poor barrels are being used. Flour barrels are frequently employed, and are in great demand. Such barrels should always be very carefully cleaned out before being used. Clean, fresh, unused barrels are always better. When handling large crops of apples, it is doubtless the best practice to buy staves, hoops and heads in quantities, knocked down, and have the barrels made up on the farm by a cooper. At the present prices of barrel stock no great saving can be made in this way, but fresh, clean barrels are secured.

APPLE BOXES.

The high prices of apple barrels, taken in connection with the changing conditions of our markets, have led to the extended use of boxes. We have experimented to a considerable extent in the department of horticulture at the Massachusetts Agricultural College in the use of boxes for apples. While we are not ready to say that boxes are better than barrels, in general, we have found their use very satisfactory. Boxes should be used, however, only for strictly first-class fruit, and more especially for the early and soft-fleshed varieties. There is probably less margin of profit in handling standard winter fruit like Baldwin in the smaller package.

Many kinds of boxes have been used and recommended. The bushel box is probably the best, under the present market conditions. These boxes are made up in a variety of styles. The one which seems to be the most attractive, and the one which we prefer, measures 10 by 11 by 20 inches inside. This gives a trifle over the standard bushel, and weighs about fifty pounds filled. The ends are seven-eighths-inch stuff, and the top, bottom and sides are one-fourth-inch stuff. These cost about $15 a hundred.

In shipping fancy apples in boxes, we have found it desirable to wrap the fruit in papers. Any clean white paper will answer, but specially made tissue paper furnished by dealers for fruit wrapping is the most satisfactory. The papers are cut 10 by 10 inches square.

Cold Storage.

The cold-storage business for apples has been rapidly developed in the last five years; it has also been greatly improved. The largest bulk of winter fruit now finds its way into the large city storage houses, from which it is marketed as wanted. Many of these storage companies accept apples for storage direct from the growers. The prices charged for storage are from 30 to 50 cents a barrel for the season; this allows the fruit to be taken out at any time up to May 1.

The keeping of fruit in what is called common storage has been considerably diminished on account of the improved cold-storage facilities. Quantities are still stored at home, however, in cellars or in houses constructed especially for the purpose. Such houses or fruit rooms are usually cooled in some way, usually by control of the ventilation. Well-built fruit houses of this type have proved very successful in the past; their value is proportionately less, however, as the city cold storage becomes cheaper and more efficient.

METHODS OF SELLING.

There are many different ways of selling apples; every man must judge from his own circumstances what method will be the most successful with him. This is a critical matter, and failure is common here. Too many men seem to think that because some one else succeeds by certain methods of marketing, those methods are universally applicable. This part of the subject should receive very careful study from the man who has apples to sell. The principal methods of selling may be briefly summarized as follows: —

(1) *Retailing in the Home Market.* — Very often apples can be taken to the near-by village or city market in small lots, and sold from the growers' wagons at fair or even fancy prices. The growers who are running vegetable or milk wagons commonly find this method the best one. In all cases where it can be adopted it is to be recommended. The fruit is promptly sold, and the money is in hand; there is no trouble with transportation companies, commission men or other agents, and very often there is no expense for packages. Naturally this method is the best suited to the disposal of a miscellaneous collection of summer and fall apples, rather than of the sale of a large block of Baldwins or some other winter variety.

A HOME APPLE-STORAGE HOUSE, HOLDING ABOUT 2,000 BARRELS.

(2) *On Trees.* — It has been customary for some years in

western States for the growers to sell the crop on the trees. This practice has rapidly gained ground in Massachusetts. The buyer comes to the orchard, and either pays a lump sum for the entire crop, or else pays a stipulated price per barrel. In the latter case the price is, say, $1.50 for the best grade and $1 for the second grade, the grading being done by the buyer. This method has considerable advantages for the men who are not in close touch with apple markets, or who are not experienced in grading and packing fruit. It relieves the grower immediately of the two great responsibilities — grading and selling.

(3) *On Commission.* — One of the best recognized methods of selling is that of shipping the fruit on commission. When the barrels or boxes are ready, they are put in the hands of commission men, usually in one of the large city markets. The commission man sells them for what he can get, and returns the amount to the grower minus the commission and any charges for freight, cartage, storage, etc. There are many disadvantages to this system, and much fault has been found with it; but, on the whole, it is the best method for a large number of growers. If a reliable commission house is selected, and if the shipper is careful and honest on his side of the transaction, good results may be expected. Most of the cursing against commission men comes from shippers who have tried to cheat them.

(4) *On Joint Account.* — This is a new method of selling, and not often adopted. According to this method, the grower turns over his fruit to the seller at picking time, receiving a stipulated amount in cash down. This is considerably less than the value of the fruit, say $1 a barrel. The fruit is then held by the seller, and disposed of at his option. At the close of the season, when the fruit is all sold, the shipper and seller have a final settlement. From the gross amounts of the sales there is deducted first the advance payment made to the shipper; then the storage, freight and other charges are subtracted; the balance is finally divided equally between the apple grower and the apple seller. In every instance which has come to our notice this method has worked very well.

THE CURRENT CROP.

It may be proper to remark that, though 1904 is scheduled as "the apple year" with us, the crop now promises to be moderate. The most reliable reports that we have seen say that it will be less than last year. This is rather a safe way of estimating, for the markets handled more apples from the crop of 1903 than ever before in the history of American apple-growing. Prices offered by buyers this fall will probably be about the same as in the fall of 1903. Though growers cannot generally expect to get better prices than a year ago, they should not be frightened into selling for less merely because this is called "the apple year" in Massachusetts.

BREEDS FOR THE FARM AND FARMERS AS POULTRY BREEDERS.

BY JOHN H. ROBINSON, EDITOR "FARM-POULTRY," BOSTON, MASS.

When I was a boy in Illinois, thoroughbred fowls were rare, and even less frequently found on farms than elsewhere. But there was one thing about the farm flocks in those days that I often think of with regret, that in the improvement of poultry stocks that feature has been lost; *i.e.* the fowls in each flock and the flocks throughout each community were, in general, very much alike.

To be sure, there was not the uniformity one finds to-day in a lot of selected specimens from a stock of well-bred birds. The best specimens were not to be compared with the finest developed specimens of to-day, for either color, shape or size. Yet I am inclined to think that, aside from the matter of color, the average farm flock of those days was more uniform than even the average fancier's flock of to-day, and there are some breeds now popular for which I would not except color, either. Observe that I do not claim that the flocks of the old days were as good as those of to-day, — only that they were more uniform.

It is to be regretted that in the improving of flocks, which has followed the introduction of new breeds, uniformity in flocks and of the flocks in the same section have so seldom been retained. There have been so many new and improved breeds to select from, that as soon as people began to go outside of their own immediate neighborhood to get new blood, and to try to introduce blood that would improve their flock, those who had before used the same kind of stock began to use some very different stocks; and, as they still continued exchanging "roosters" and eggs with their neighbors, the result was that the flocks often became fear-fully and wonderfully mixed. The poultry stocks of the country, considered as a whole, continue so. There are here and there farming localities where nearly all farmers keep the same kind of fowls, and in some sections flocks of certain breeds are much more numerous than elsewhere; but there is not anywhere such greater uniformity and better general excellence as might reasonably be expected after two-thirds of a century of improvement.

That this last statement is not in accordance with general ideas I am well aware. Any one who will consider the lack of uniformity in the poultry found in the ordinary farm flock, as well as in the ordinary town flock, and who will observe the small proportion of only fair-sized fowls, must admit that there are grounds for it. We need not, however, depend merely on observation. Here is an illustration. A few years ago I had a lot of Light Brahma hens I wanted to sell in a bunch, and at once, in order to get them out of the way. I could not sell them to any of the local buyers, because they were too large for their trade; so I asked a buyer in a section the other side of Boston, where Brahmas were bred more than any other fowl, if he could use them. He agreed to take them, and turned the deal over to a Somerville buyer, who sometimes made trips to my town.

The lot of hens sold weighed at this time only a little over seven pounds apiece, average live weight. They had been laying heavily for between six and seven months, and were not in good condition. Four months before they were sold they would have averaged better than nine pounds, many of the hens weighing when in good condition ten to ten and a half pounds. When the man who came for them was weighing them, he remarked that they were the heaviest and largest hens he had had for a couple of years.

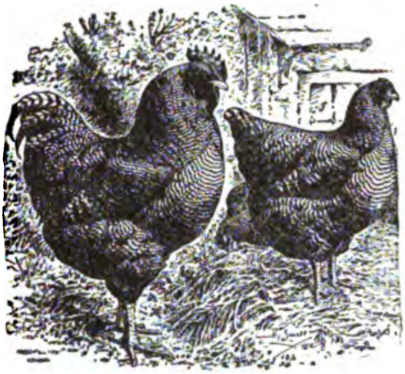
Talking about weights of poultry, one thing led to another, until finally he asked: "What do you suppose is the average weight of the fowls we buy?" I guessed, "About five pounds." "Well," said he, "the most of the hens we get weigh three to three and a half pounds. Hens that weigh four to five pounds we call large hens, and we get very few lots that will average four pounds."

Since then I have taken some pains to learn from other buyers — and to see for myself as I went about among poultry keepers — whether his statements were correct; and I have to conclude that they were, and that the average fowl of to-day is but a slight improvement over the best ordinary fowls of sixty or seventy years ago. Why is it? I think the answer is, there has not been the improvement of poultry generally that there ought to be, because the farmer is so seldom a poultry breeder.

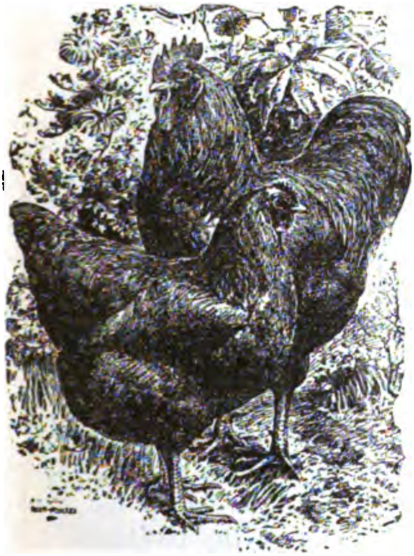
That does not indicate that farmers as a class are different from other poultry keepers. The ordinary poultry keeper, even the ordinary fancier, is not, strictly speaking, a breeder. But, inasmuch as the farmers produce by far the greater part of the country's supply of poultry and eggs (some authorities say nine-tenths of it), what farmers generally do or fail to do with regard to poultry is of vastly more importance than what the rest of the poultry keepers do or neglect to do; for, if all the other poultry keepers by general consent should adopt a course which would greatly improve their stocks of fowls, the effect on the whole market product would be small, as compared with the results if half or even a third of the farmers were to pursue the same course.

Most people who raise poultry are just poultry *growers*. They hatch the eggs of such stock as they happen to have. They keep on, year after year, reproducing fowls, without any definite ideas as to the particular points of excellence which it would be desirable to establish in their stock. They interest themselves little if at all in the principles of breeding; they follow no definite system. If they use some pure-bred stock, they give no special attention to preserving its characteristics. Oftener, indeed, such special attention as they give it is in the line of getting rid of whatever fixed character their fowls possess. The average poultry keeper has a perfect mania for crossing breeds, and nearly always he makes crosses without definite ideas about what he is likely to get, or what he wants to get. Then, not finding the product pleasing, he crosses again and again, until, becoming disgusted with his chickens, he either leaves them to breed together by chance, or gets some new stock and begins another series of crosses.

Poultry breeding properly consists in the intelligent, systematic mating of fowls to produce progeny having the desirable qualities of the parents preserved and if possible intensified, and the undesirable qualities either reduced or bred out entirely. A poultry breeder is not necessarily a fancier or a breeder of thoroughbred stock. One who works systematically and persistently for the development of common or grade stock is really more of a breeder than many growers of thoroughbred stock. If his ideas are good, and he is reasonably successful in his efforts to realize these ideas in his stock, he accomplishes more than most of those keeping thoroughbreds. I have known, first and last, a good many breeders who have made for themselves, from common stock, flocks of fowls in every practical respect equal to average good thoroughbreds. They were virtually pure bred, — as much so as many of the standard bred stocks.

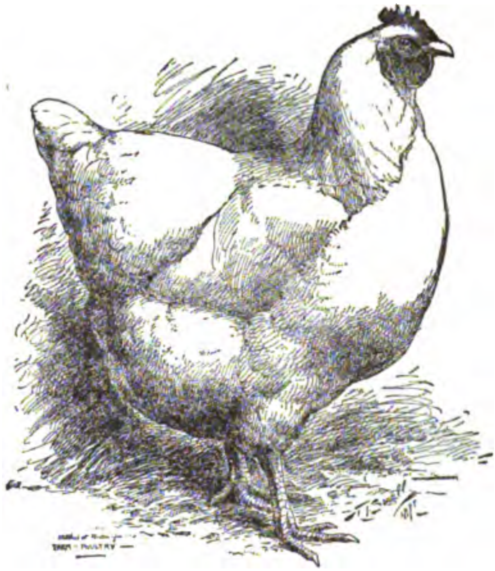


Pair of Ideal Barred Plymouth Rocks.



Pair of Ideal Buff Plymouth Rocks.

But there are two serious objections to working in this way. The first is, that it takes very much longer to accomplish any desired results by breeding from common stock than by breeding from thoroughbreds. Though, as has been said, many thoroughbreds are by no means all that they should be, it is always possible to get specimens of some popular thoroughbred variety having the qualities one desires well developed; and from such stock as a foundation a careful breeder can accomplish more in three years than he could in three times as many years if he began with stock of no particular breeding.

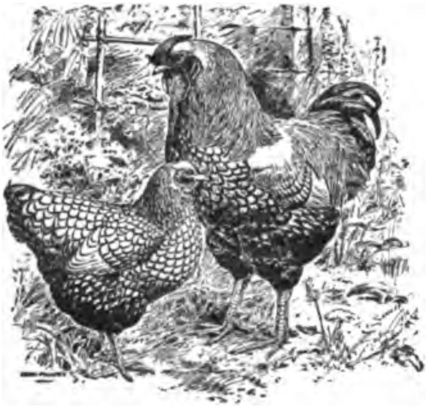


IDEAL WHITE PLYMOUTH ROCK PULLET.

This is a point which has been demonstrated over and over. It is a point which needs to be emphasized often, for one of the most prevalent errors about poultry breeding is the opinion, held by many who have a very good idea of what they want, that they can develop it themselves by the careful improvement of inferior stock more economically than by paying the high prices which it is frequently necessary to give in order to get good stock of the type wanted. I would not advise any one who needed to consider economy — as most of us do — to buy fine breeding fowls in large numbers at big prices; but it is often the best economy to pay almost an extravagant price for a few good birds, to be used as foundation stock, rather than give time and attention to the development of a larger flock of less meritorious quality.

The principle is exactly the same as that upon which a farmer or gardener, who wants some of a new variety of vegetable, grain or fruit, so expensive that he does not feel that he can afford to buy it in quantity, proceeds. He buys a small amount, and simply uses it as a foundation stock from which to produce seed or plants for a large crop in some future year. He should do the same way with poultry, and should have as much patience in working toward the results he wants.

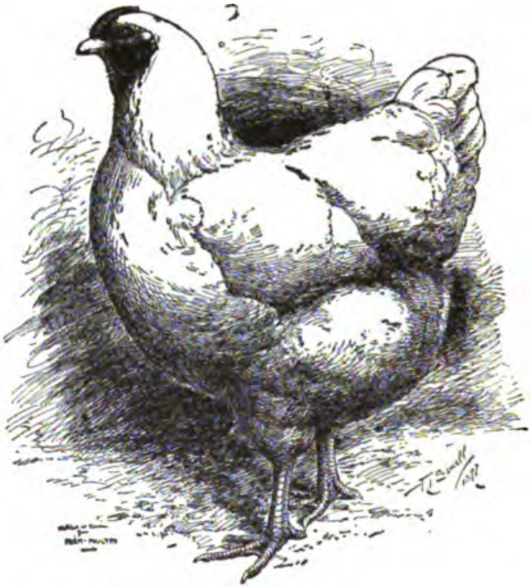
The second objection to developing common stock is that, in working along lines in which no one else is interested, one almost invariably comes before long to the place where he needs new blood; but, as he cannot get it from stock bred on similar lines, there being no other such stock, he has to either go without new blood or use something different. He has a choice of only two equally unsatisfactory courses. The dilemma is easily avoided by using fowls of a popular breed, in which it is always possible to get some such stock as one wants.



PAIR OF IDEAL SILVER LACED WYANDOTTES.

What puzzles the person who wants to get a few good birds to use as foundation stock is where to go to get such stock. He finds many breeders, all claiming to have just what he needs. If he is where he comes in contact with many people who have at one time or another bought stock from these breeders, he is very apt to come across one or more people who tell him of experiences with this, that and the other breeder that make him think he had better not risk an order with any of them. I get scores of letters every year from such people. They write to me supposing that I can tell them all about the different stocks, — which is good, which is bad; and about the breeders, — who is reliable and who is not. They say something like this: "I have only a little money to spend for fowls. I have had to save very carefully to get it, and I cannot afford to buy stock that will not prove satisfactory."

Now, I am so situated that I am not at liberty to recommend one man's stock in preference to another; and, even if I were at liberty to do so, I would be very reluctant to express an opinion as to the best place to buy stock of any particular kind, for I found out long ago that unless you know what kind of stock a man wants, and know that he too knows what he wants, advising him where to buy is too risky. If he is not satisfied with the deal, he blames you more than any one else connected with it. I can do better by the man who wants to know where to go to buy, by telling him how to buy.


IDEAL WHITE WYANDOTTE PULLET.

In the first place, he must know what he wants. If he doesn't know, he must find out before buying, and he must learn it so that he is sure of his knowledge.

To illustrate: suppose a man concludes that he wants fowls for a certain purpose, and is told that White Plymouth Rocks would suit him. If he was brought up on a farm, he probably does not need to be told that all White Plymouth Rocks are not alike; for he has seen the production of plants and animals of many kinds, and has noticed that individuals from the same seed or the same parents vary sometimes a great deal. The first step, then, is to learn what is the correct type of White Plymouth Rocks. I think the best way to learn this is by carefully studying a good ideal illustration of a White Plymouth Rock. The ideal drawing represents a bird perfect, according to the artist's interpretation of the ideas of the best breeders and judges, in every section, — a bird free from faults. Sometimes photographs are obtained which are quite as good, and look more true to life; but the photograph so often fails to do typical birds justice in their best points, and so often distorts some sections, that I think it much safer for those who want to learn the best types in the different breeds to study the ideal drawings first, and so learn to make proper allowance for faults in specimens they see, and also in photographs and drawings that are portraits of individual birds, and hence show in some degree the faults of the fowls they represent.

It will help one to appreciate the points of excellence in a breed if he will study, in connection with the ideal representation of it, the authorized description of the variety published in the "Standard of Perfection." This description tells him briefly what the drawing shows him, and by studying the two together he gets a better apprehension of the type than he could from either alone. From book and picture one who had never before seen a White Plymouth Rock could get an idea of it good enough to make it impossible for him to be imposed upon with fowls of different type, or with fowls having serious blemishes.

PAIR OF IDEAL LIGHT BRAHMAS.

Even if one is somewhat familiar with a breed, it is well for him to justify his ideas of good type by comparing them with approved standards. Theoretically, the way to learn correct types would be by study of the best birds; but in practice the first knowledge of what is right is more surely gained by studying ideals, because by forming one's ideas from a model correct in all sections one avoids the common error of learning to overlook readily the weak points which may be associated with special excellence in the best birds he sees.

Having learned what a White Plymouth Rock should be, the seeker after good stock is now prepared to inspect some stock for the purpose of buying when he finds what he wants. I advise making a personal inspection of the stock from which one buys, and personal selection of the birds bought, if that is at all possible.

IDEAL SINGLE-COMB RHODE ISLAND RED, MALE.

With the ideal White Rock imaged in his mind, the buyer goes into a flock of White Plymouth Rocks and begins to look for specimens resembling that ideal. He knows that the type he is looking for is a rather long and deep-bodied bird, full-breasted, neither too low nor too high on the legs to look symmetrical. The picture he has studied has given him an idea of the general appearance and carriage of the bird; and if he has any eye for outline, he will at once single out of an ordinary flock some birds as typical and some as not typical. These typical birds, if on closer inspection they are found free from serious faults, and if they are vigorous and healthy looking, are the kind of birds he wants, and he should take no others. He should pay any price in reason for specimens of the right general type, rather than take as a gift specimens not of that type.

The fowls being satisfactory in appearance, the buyer naturally wants to know something of their laying capacity.

For this he must usually take the seller's word; but if it is convenient for him to visit the place a few times before buying, and notice the eggs in the nests, he can form a tolerably good estimate of the general laying capacity of the stock, and get accurate knowledge as to how the eggs run for size, shape and color. If, as may happen, he fails to find any specimens in the flock that strike him as typical, the thing to do is to postpone buying until he can satisfy himself whether his judgment of the stock was right or not.

If he cannot buy White Rocks at home, it would be well worth his while to visit yards elsewhere in his quest for stock, and not under any consideration to buy until he can get what he wants. Even if he is unable to personally select his stock, he can protect himself in buying from a breeder at a distance by carefully stating what he wants, and insisting that fowls be shipped to him on approval. If he takes the necessary precautions to protect himself at every point from his own inexperience, as well as from the possible disposition of some with whom he deals to take advantage of his inexperience, a man runs little risk of parting with his money for fowls that are not what he requires. The risk cannot be absolutely eliminated, but it can be so reduced that the buyer is reasonably safe from loss. It may take him some time to find what he wants and to get started, but the delay is not lost time if he is learning to buy on his own judgment; for, as a rule, one has to learn to do that before he gets fairly started in breeding poultry, and it is much better and more economical to learn before buying than to learn by buying what you do not want.

IDEAL SINGLE-COMB RHODE ISLAND RED, FEMALE.

Another point comes up here. Suppose one makes a fruitless search for fowls of the kind he had decided he wanted, — cannot run across birds that suit him, — but in the mean time does find birds of another variety that seem to him to be just what he wants; should he drop his first choice and take the others? Supposing a case as stated, I would say yes. The fowls which suited might not be the best type of their kind, according to prevailing opinion, but if they are what is wanted, the name by which they are called and their superficial points are of only minor importance. While I have used the White Plymouth Rock in the illustration above, any other Plymouth Rock is the same in everything but color. The Wyandottes and Rhode Island Reds are in the same class, and differ practically from the Plymouth Rock principally in size and shape, and not radically in either of these respects. Ordinarily, a Massachusetts or New England farmer would not want to go outside of these three breeds to look for stock. Indeed, this is the class of stock best adapted to the wants of most poultry keepers everywhere; and, as a rule, the preference of a poultry keeper for any particular variety of this class is due to his having happened to get stock of that variety which suited him.

A brief comparison of the three breeds and their varieties will indicate how like they are in essential qualities, and also show the superficial differences which would sometimes be considered in making a choice, and which in a few cases do have a marked influence in determining the popularity of the variety.

All are medium-sized fowls, the Plymouth Rocks as a class a little larger than the others, and a little longer in coming to maturity.

Of Plymouth Rocks there are three varieties, — Barred, White and Buff. Unless he had a color preference, a taste for appearance to satisfy, it would make no difference to the poultry keeper who wanted a fowl of the Plymouth Rock type which of the three varieties he took.

In Wyandottes the number of varieties is greater, and most of them are more difficult to produce in such uniformity of color as will satisfy even a moderately critical taste.

The White and Buff Wyandottes are the only varieties of the breed which the farmer looking for stock would do well to consider, if he found what he wanted. Of the other varieties, the Golden Laced, Silver Laced, Partridge or Golden Pencilled, and Silver Pencilled, are difficult to breed; and the farmer who is not something of a fancier would not long be suited with them. The Black Wyandottes are comparatively rare, and their color does not recommend them to many practical poultry keepers. The Columbian Wyandotte, with markings of a Light Brahma, should make a first-class variety for the farm. The present objection to recommending it generally is that the breed requires very careful breeding to bring it to such stage of color development that the average novice in handling the variety will get encouraging results in that feature. Of course the novice, in handling any variety, as in doing work of any kind, makes mistakes at first. It takes a year or two of experience in breeding to learn to avoid the most serious mistakes. But the poultry keeper who wants to make himself a good breeder of fowls will succeed better by beginning with well-established varieties, because then his first and hardest year's work is not made more difficult by lack of development or permanence of the special characteristics of the varieties he is working with.

The ideal Rhode Island Red is of a type intermediate between the ideal Plymouth Rock and Wyandotte type, but comparatively few specimens have yet been produced showing that type conspicuously. The average Rhode Island Red resembles the average Wyandotte more than it does the Plymouth Rock. There are two varieties, the Rose Combed and the Single Combed. A third variety, Pea Combed, like a Brahma, is bred by a few breeders, but has not attained a popularity at all comparable with that of the other two, which in many sections of New England seem to have matched the popularity of the popular varieties of the Plymouth Rocks and Wyandottes.

For usual farm conditions in this country no other breeds need be considered. In the section where soft roasters for the Boston market are grown on a large scale, Light Brahmas are very generally kept by farmers to supply growers of this class of poultry with eggs for hatching.

Having obtained stock suitable for his requirements, the farmer is ready to begin his work as a poultry breeder. The difficulty of getting just such stock as he wanted will generally have convinced him by this time that there is not nearly as much of it produced as there ought to be. There ought not to be any considerable proportion of the poultry produce each year that did not in a general way fill most of the requirements for a good fowl for the farmer. Allowing for differences in size and in purpose, it is still true that, whatever the variety or whatever the purpose in breeding them, the aim should be to produce well-developed, healthy, vigorous fowls, and that these points should always be considered first.

For the fancier, to whom superficial qualities, such as perfection of comb or crest, or excessive development of foot feathering, or accurate markings, or purity of color, seem of prime importance, and really are made so in the competitions for which his birds are produced, we can find some excuse for sacrificing the substantial qualities of fowls to the superficial, or for being so impressed with features that are for the time being a fad that he neglects the preservation and development of useful characteristics; but the farmer, as a breeder, has no excuse for not developing in his fowls the qualities of most value to him, and, having once clearly apprehended for himself what these qualities are, all his efforts as a breeder should be directed to making them uniform in his flocks.

It does not take long to do this, if he can bring himself to adhere rigidly to the fundamental rules of good breeding, *i.e.*: —

First. — To breed only from the best obtainable specimens, following this rule year after year; demanding that his breeding stock as individuals shall have the merit he seeks in themselves as well as in their ancestors.

Second. — To give the chicks of his breeding stock the care and food necessary to make them attain their best possible development.

In a previous article on poultry keeping for the farmers of Massachusetts I had occasion to refer briefly to the fact that, as a rule, farm-grown stock did not attain the best development possible. I would not go so far as to say that the best development is to be sought for all the stock produced on the farm, regardless of the cost of obtaining it, though I think better development than is usual could be obtained on many farms at an insignificant cost; but I would by all means urge every farmer who wishes to improve his poultry to give to chickens, from which his stock birds will be taken, all the attention that they need to bring out all the merit there is in them.

Beginning with good stock, breeding carefully and growing his fowls well, a farmer can in a very few years have a stock of uniform high excellence that will be an ornament to his farm, will be far more profitable than the old, carelessly bred stock, will be a source of pride to him, and stimulate his neighbors to follow his methods.

And here we come naturally to the consideration of another point, — the relation of the farmer as a breeder to other farm poultry keepers, especially to those in his immediate vicinity. It is of quite as much advantage to him to have his neighbors generally keeping just as good fowls as the fowls he has improved to his liking. One may take a selfish sort of pride in having better poultry than those about him, but it is not really much to his credit, unless they too have good poultry. It is to the advantage of the farmer and breeder of poultry also to have the kind of poultry he keeps popular throughout his vicinity. I doubt whether there is any one condition affecting the improvement of poultry which has a surer and steadier influence for the preservation of practical qualities than to have the stock almost universally kept in a locality, and all the poultry keepers alike interested in getting practical and profitable results.

It remains to speak of the satisfaction of breeding poultry. The mere grower of poultry gets little pleasure out of his work with it. The breeder always finds something in his work to compensate for the drudgery of some of the tasks of caring for poultry. His fowls begin to assume an individuality in his sight and in his thought. Each succeeding year he becomes more adept in anticipating the quality of the chickens he will hatch, even though he may make no progress in counting them before they are hatched. Nor is the use of what he gains by intelligent efforts in breeding poultry limited to his work with poultry. In learning to work with the principles of breeding, he is providing himself with a better equipment for every other branch of his farm work, for the same general principles of production run all through the animal and vegetable kingdoms.

BEE KEEPING: HOW TO MEET ITS DANGERS AND DIFFICULTIES.

BY BURTON N. GATES, WITH SUGGESTIONS FROM PROF. C. F. HODGE,
COLLEGIATE DEPARTMENT OF CLARK UNIVERSITY, WORCESTER.

Massachusetts produces less than one-fourth of the honey consumed in the State. The past year this amount was approximately 200 tons, of which 15 tons came from Vermont and upward of 145 tons from California.* With a population of 2,805,000 this would give .14 of a pound, or less than two tablespoonfuls of honey, per person as a year's ration.

The average yield of honey per colony in the above-named States in 1900 was as follows: —

	Pounds.
Vermont,	14.2
Massachusetts,	13.0
California,	28.3

while in Texas, which produced the largest amount of any one State, the yield per colony was only 12.2 pounds.

These averages are all low, and must be considered to mean, in the main, inefficient management; yet the colonies in California are being handled more generally according to modern and improved methods. Not infrequently well-managed apiaries in Massachusetts produce from 30 to 50 pounds, and yields of over 100 pounds of surplus comb honey are not rare. With the adequate development of the industry, there is no doubt that Massachusetts could produce all the honey annually consumed within the State, and even beyond that amount, without straining the limits of our natural resources.

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* Estimate by Hon. Walter H. Blodget of Worcester.

We have been requested to make this article supplement somewhat the excellent paper, " Bee keeping, its pleasures and profits," by Prof. James B. Paige.* In order that we may enjoy the " pleasures and profits " of bee keeping, it is certainly needful that we be armed and equipped to meet the difficulties and prevent the losses which sometimes threaten the industry.

With a capital value in 1900 of $10,186,000 for the United States as a whole, the bees returned, as profits and wages, products to the amount of $6,665,000. This is about 65 per cent interest on the investment, and returns of 100 to 200 per cent are sometimes realized in special cases of good management and favorable conditions. The large returns indicate that bee keeping is an industry which liberally rewards intelligent effort, and there is no agricultural pursuit in which accuracy and the determination to do everything required at exactly the right time count for so much. No similar industry yields such large rewards, and no occupation is more exacting in the matter of promptness when anything needs to be done. Unless we are sure of being able to do each part of the work at the proper season, we should not attempt bee keeping.

WINTERING BEES.

Of all the dangers and difficulties confronting the bee keeper, that of wintering his bees in this latitude and climate, with its sudden changes, was brought most closely home to many this past winter (1903–04).† Some lost every swarm, others 80 per cent. The man who successfully brought through to spring 50 per cent or more of his colonies is indeed to be congratulated. But the extreme and prolonged cold was not the chief cause of this excessive loss. Bees have been known to winter safely under all manner of conditions: in stone jars; thin wooden shipping boxes, both shallow and deep; in glass hives; and even in hives with no bottom to prevent the wind from sweeping up between the combs.

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* Massachusetts Crop Report, July, 1903; also Agriculture of Massachusetts, 1903, pp. 399–411.

† The loss was apparently as great in the winter of 1904–05.

Yet the bees must have maintained their normal temperature. Something besides outside protection is necessary to the successful wintering of bees. Certainly one of the necessities of successful wintering is plenty of food, chiefly honey, although Cheshire * states that pollen is essential to strong wintering. He says: "Honey the bees consume to enable them to produce heat and give forth energy, and pollen to renew their nerve and muscle waste, selecting the one or the other, as nature needs." These foods, it has been demonstrated by experiment, are best arranged in the hive by the bees themselves, and not supplied by slipping into the cluster late in the fall a frame or two of honey. This may act like a division board, and separate the cluster. In order to avoid the need of doing this, if a swarm is weak in the fall, feed the bees early in September a syrup of sugar and water, half and half, or extracted honey, if you have it. The bees will then deposit the food where they can use it when clustered in winter.

Another factor of extreme importance is a population of young, thrifty bees in a colony. Bees which have worked all summer, gathering honey and raising brood, are worn out, and cannot survive the winter, if they do the fall. During the winter bees are quiet; there is no wear and tear upon them. They merely hang in a compact cluster within the brood nest, moving about only enough to procure food from time to time. Thus young bees, when winter sets in, are capable of resting throughout the cold months, being fresh when spring opens up.

To summarize: the two essentials are, have plenty of naturally arranged stores, with plenty of young bees. Bees enough to cover six standard Langstroth frames will usually winter well.

Besides these essentials, some protection for the outside of the hive is desirable. It has been customary for years to winter bees in long, low sheds or tenement hives. These are expensive and cumbersome, and are apt to harbor mice, which sometimes destroy the bees. Better satisfaction is generally obtained by the use of chaff or double-walled

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* Frank R. Cheshire, "Bees and bee keeping," Vol. II., p. 525, London, Eng.

hives. Still further in the direction of simplicity, Mr. Arthur C. Miller of Providence, R. I., has worked out the plan of wrapping the hives in four or five thicknesses of paper, covering top, sides and ends. Tarred roofing paper for the outside layer is preferred, because waterproof and black, the color serving to absorb heat. Mr. Miller has found that bees may be wintered safely in any single-walled hive, even a quarter inch in thickness, with this simple protection. The paper is held in place by strips tacked around the bottom.

Cellar-wintering is another method, little practised in Massachusetts, yet of great value in Canada or the west. After being in some disrepute for several years, it is now coming to the front again as a successful method for cold and exposed locations. A dark, dry cellar, with good ventilation, in which the temperature can be kept at about 45° F., is suitable for the purpose. The hives, with the bottom board removed for ventilation, are set on timbers. They are put in after settled cold weather begins in the fall, and are not brought out until spring is well arrived, many leaving the bees in winter quarters until the first of May.

THE BEE MOTH OR "WAX WORM."

Probably the greatest of all losses to bee keepers in the past have been caused by this insect. It is said to have been chiefly responsible for the decline in bee keeping during the past century. In the earlier days of the industry in America farmers kept their colonies in any receptacle, regardless of uniformity. Sometimes bees were hived in straw skeps, as was the old custom in Europe; more frequently they were kept in old boxes of odd dimensions, or even in barrels or kegs. Again, if a swarm was found wild in the woods, the tree was sawed off above and below the colony, and this section was then taken home and set up among the boxes and barrels. Such an apiary certainly could not present the neat appearance of the modern uniform hives. When honey was taken, the whole colony had to be sacrificed, usually being "brimstoned." In such hives, if the wax worm gained entrance, the colony was usually beyond recovery before the owner knew what was going on. Even later in the century, when bees came to be generally kept in uniform box hives, there was no way of gaining access to the combs, and hence the wax worm could be controlled no better than in the hollow log. The moth increased unchecked, and, until the movable frame hive was invented, nothing could be done to save the industry.

At bottom, the difficulty was that bee keepers did not study their enemy, and, from a knowledge of the life history of the bee moth, discover some means of checking its attacks. Even at present, with all the devices which make the control of the pest so easy, no bee keeper is safe who cannot recognize the insect at a glance in any of its different stages. The moth is about three-fourths of an inch in length, dull, ashy gray, streaked in imitation of a weathered chip, and may be seen flitting rapidly about the entrance of the hive at dusk. The life history of the bee moth may be briefly sketched as follows. The moth deposits her spherical white eggs singly about the entrance or in the crevices of the hive, — inside, if she can gain admittance. As soon as the caterpillar hatches, it begins feeding on the combs, where it tunnels along the midrib, the tunnel or gallery increasing in size as the larva grows. It thus burrows through the bases of the cells, possibly destroying great numbers of eggs and young bees, and as it goes it lines its passageway with a tough, silken web. In three or four weeks the caterpillar attains its growth, and is about one inch in length. It then withdraws to some secure crevice, often gnawing a cavity in a frame or in the sides of the hive, and there spins a strong cocoon. In this it changes into a pupa, and after from ten to fourteen days emerges as the adult moth, ready, after mating, to repeat the life cycle.

If the caterpillars gain entrance to a hive early in the season, and produce four broods before winter, as is usual in this State, it is to be expected that a colony will be much weakened from loss of young bees, and will not be able to survive the winter. This was the condition in the old-fashioned hives, in which so many colonies were destroyed. These were left about the farm, a mass of webs and cocoons, which acted as a breeding place for the whole neighborhood. Had the farmers known the nature of the pest, they could have easily saved much further infestation by merely destroying the old combs and hives as fast as the bees died.

To-day, however, things have changed; the ravages of the moth are checked, so that in some States it is nearly exterminated. This has been brought about mainly by the improved hives, with movable frames, which enable every part of the colony to be examined. Even with such facilities, the common black or German bee, of which we will speak later, requires constant attention. The hive must be opened at least once in eight or ten days; and whenever the wax worms have gained a foothold, the caterpillars can be traced in their galleries, and with a long pin or knife blade can be cut out or killed. Even with this constant attention, infested black bees are frequently lost. From this it may readily be seen how impossible the task of fighting wax worms was years ago in the old box hives.

An equally important move toward controlling the bee moth was made when the United States Department of Agriculture introduced Italian bees into this country. Fortunately, these and some of the still more recently introduced races do not tolerate the presence of a wax worm in their combs. Wherever the bee moth exists, and we regret to say that this probably includes all of Massachusetts, simply requeen with Italian or other moth-proof strain, and the battle is won.* Hence, by the use of modern hives and superior races of bees, the bee moth problem entirely disappears as a difficulty. In reality, if this pest serves as a means of improving methods and stock, it should be looked upon as a blessing in disguise.

ROBBING.

This is a real and serious difficulty, to avoid which the bee keeper should carry with him an ounce of prevention, and use it all the time. As Mr. Root expresses it, "A stitch in time will save a great many more than nine in this case." Phrasing the proverb to suit the bees, the love of honey is the root of all evil. Generally, robbing may be traced to honey spilled or left carelessly where bees can get at it during a time of scarcity or honey famine. The difference between preventing any access to honey, and stopping the riot when an apiary is in an uproar of robbing, may be likened to that of putting out a match and a conflagration.

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* For the method of introducing new races or strains of bees in your apiary, refer to some of the standard works on bee culture, under head of "Introducing queens." Many of these works were mentioned at the close of Professor Paige's article.

Robbing may be detected by the high-keyed, angry tone of the bees, and their quick and nervous flight. Great apparent uproar and confusion among the bees is sometimes occasioned by the young bees swarming out for their daily play spell. Beginners often mistake this for robbing; but the mild and joyous hum of the bees, and the absence of fighting about the entrances, should serve to distinguish between the two. When we discover the hive that is being attacked, we shall probably find bees fighting at the entrance, and heaps of dead around the alighting board, while others are trying to gain admittance through cracks about the hive. They are likely to be cross, and to sting promiscuously, causing injury to stock and annoyance to passers-by.

To prevent robbing, we must never have honey about in any form, the taste of which may start the craze. Avoid opening hives as much as possible during periods of honey scarcity. Keep all colonies strong if possible, and, when honey is not coming in, contract the entrances of the weaker swarms to the width of one or two bees. Lastly, and most important of all, keep only "civilized" bees. Here is another reason for improving stock. A small nucleus of Italian bees or of the other improved races will successfully defend their hives under conditions in which a moderately strong swarm of black bees would be overpowered.

If robbing has begun, immediately contract the entrances of the hives attacked to the width of a single bee, and throw a handful of weeds over it, to further confuse the enemy. If robbing bees are numerous, it is also well to smoke them vigorously. In cases of persistent robbing, the plan of exchanging the greater part of the frames of the two hives concerned is sometimes to be recommended.

BEE DISEASES.

We now come to the grim part of our theme. For a man to say that the bee moth has injured his apiary, is a frank admission of ignorance or neglect on his part; for him to bewail his afflictions from robbing, marks him as one who is careless if not slovenly in his methods; for him to say that his bees have foul brood, carries as yet no stigma, for we do not know how it originates or where it comes from. This tells us simply that he is unfortunate.

Brood diseases and dysentery were known in the days of Aristotle. Baron Dzierzon, in 1848, lost his entire apiary of 500 colonies from an epidemic of disease.

A condition commonly called dysentery sometimes appears in an apiary, generally among the weaker swarms, especially in the early spring or after a long period of confinement of the bees within the hives. Bees normally void all excrement on the wing and outside the hive, but under the above conditions they may soil the hive, combs and one another with yellowish-brown stains. This may go on until the whole colony perishes, a mass of mouldy bees in the bottom of the hive.

Of course a good many bees may die, especially in unfavorable weather, of old age and weakness in the early spring, and we should not be surprised to find possibly a quart or two dead in front of a hive at such times. I have never known it to go farther than this, unless the entrance became clogged with dead bees. Generally, if the bees are able to fly freely for a day of bright, warm weather, the trouble disappears, and, with a little help in scraping the bottom board, etc., the bees clean up the hive in short order. This is generally done as a matter of course during the first warm days of spring, when the bees begin to fly. In exceptionally bad cases, it may be advisable to shake the bees onto clean combs in a clean hive.

In severer cases, bad food, especially honey made by the bees from "honey-dew," is probably at the root of the difficulty. Honey-dew is excreted by aphides or plant lice, which often cover the leaves of trees in dry seasons with a sweetish substance, giving them the appearance of being varnished. Bees do not ordinarily collect this, if they can find nectar in the flowers; but as a last resort, in seasons of scarcity, they may attempt to use it for winter stores. As stored in the combs, such honey is commonly very dark, and has a nauseating taste. Careful bee keepers in preparing the bees for winter generally remove the frames containing such honey, and either feed sugar syrup, or supply, in good season and carefully placed, combs of clean and wholesome honey.

In this connection, a word of caution is in order against *allowing bees to soil washings* on the line. With bees in cities, this nuisance often causes ill feeling among neighbors. To prevent this, simply confine the bees on wash days, or until all clothes within the danger line, say within a radius of a hundred feet, are taken in.

By far the most serious diseases of bees are those which attack the brood. They may occur any time in the summer, and are known under the popular names of "foul brood," "pickled brood," "bad brood," "black brood," or "the New York bee disease," and so on. Of these, the differences, if any, are so slight and technical that we cannot here consider them. For simplicity, then, we will speak of the brood disease which has gained a firm hold in certain localities of Massachusetts as *foul brood.*

A foul brood colony in a neighborhood should be regarded as dangerous to the bees as a case of smallpox is to man. The strictest laws should protect bee-men from the possible contagion through neglect of a diseased colony by some thoughtless neighbor. Massachusetts affords no such protection, unfortunately, as is secured in New York, Michigan and other States. In New York, inspectors, one to each of the four divisions of the State, have been appointed by the State Department of Agriculture to visit everybody who keeps bees. Wherever a bad colony is found, it is either treated and cured or destroyed, according to the discretion of the inspector. The result is that fewer cases of foul brood, or, as they term it, black brood, have been found this year than last. It is expected by this means to stamp it out entirely within a few years.

Although the disease is not so general in Massachusetts, it is here, and will surely spread if some efficient measures are not taken to stop it. We need a live State bee keepers' association, with branch societies in every county; then, by a vigorous effort of our combined forces, we may insure protection and cure.

The first signs of the disease are: failure of the young bees to hatch; dead larvæ are dragged from their cells; capped cells are sunken or torn open. Later, as the disease progresses, putrefaction sets in; the once milk-white larvæ turn yellow, then brown and black, and sink, a slimy mass, to the lower side of the cell. These putrid larvæ have sometimes a characteristic "glue-pot" smell, and are viscid and ropy, — characteristics which are not constant, and which have for this reason caused people to believe there are many kinds of foul brood. If the dead larval mass is allowed to remain in the cell, it dries down to a chip or scale, which closely adheres to the wall. The next larva raised in that cell comes in contact with the disease, and dies, and thus the colony dwindles away.

The cause of the disease is definitely known to be a bacterium, — *bacillus alvei*, a microscopic plant. It lives upon the tissues of the larval bee, and when mature breaks up into spores, also microscopic, capable of living a long time, under all sorts of conditions of temperature and dryness. The spores correspond to the seeds of higher plants, and they are found not only in the cells where the brood has died but also in the honey, pollen, and upon the walls of the hive. Thus it is important that no material from a diseased swarm comes in contact with healthy bees.

This may be prevented by isolating a diseased swarm as soon as discovered. If the swarm is weak, it may be best to burn the bees and disinfect the hive. If strong, they may be cured by the following treatment, which has been practised with success: open the isolated colony toward night, when danger of spreading the disease by means of robber bees is past, shake the swarm from the infected combs onto fresh frames of foundation in a clean hive; return the new hive to the old stand, and allow the bees to use up what honey they have in their honey sacs, drawing out the foundation. As soon as the bees begin to drop from the frames from starvation you may begin to feed, but not before. By this means none of the honey carried from the old hive is deposited in the new cells. Bees treated thus are usually cured.

Further care must be taken to destroy the germs in the old hive. Cheshire says: "The destruction of the hive is never necessary. It may be used again with perfect safety, if, having been washed and dried, it be scrupulously painted with a mixture of two parts methylated spirit and one part carbolic acid crystals, or one and one-half parts good white fluid carbolic acid. This mixture not only destroys all bacilli, but it glues them down by dissolving the propolis." For washing, corrosive sublimate solution (mercuric chloride), one-eighth ounce in a gallon of water, may be used to advantage; a thorough rinsing must follow.

Fumigation of the hive with formaldehyde gas has been advocated, but this has not been found to penetrate the wax and honey sufficiently to kill all germs. A better method is to extract the honey and melt up the combs. Heat these for an hour or so as high as possible without burning. This will kill all germs. Then run off the wax, which may be again used; the honey also is rendered wholesome for either man or bees.

After handling diseased colonies, the hands and all tools must be thoroughly disinfected before permitting them to touch healthy stock.

So far as we know, every case of foul brood arises from infested bees in the neighborhood. A hive dies out, the owner neglects to examine it, possibly does not know that it is dead, but other bees rob it out and carry the germs wherever they go. Thus, like an epidemic in a city, the disease spreads until checked. When brood disease strikes in, the only hope of saving the industry in a neighborhood lies in prompt and energetic action on the part of every bee keeper.

The main difficulties of bee keeping have been considered, and none of them are insurmountable. A few minor dangers remain to be briefly noticed.

Spraying trees during fruit bloom has caused severe loss in some sections by poisoning great numbers of bees. Spraying at this time is never necessary, and is prohibited by law in some and should be in all States. The direction given by Prof. M. V. Slingerland in Cornell Experiment Station Bulletin 142, p. 58, "The codling moth," is: "*Never spray a fruit tree when it is in blossom.* You can reach the insect and fungous enemies as effectively, and in some cases more so, either just before or just after the trees bloom." You may then be certain of poisoning no bees.

Mice and rats have a sweet tooth, and, if allowed to, will work havoc in an apiary in winter. This may be prevented by tacking over the entrances wire mesh of proper size, not to prevent the passage of bees, but to keep out the mice. All surplus combs or honey must be stored in mouse-proof rooms or boxes. A better way still is to completely rid the premises of all such pests, and then keep traps well baited and set the year round. Place no dependence on cats to do the job thoroughly enough; and, with the pests once inside the hives, the cats cannot get them.

The kingbird is supposed to feed upon bees, the name "bee-martin" or "bee-eater" being usually applied in some sections. Stomachs of 281 birds shot about apiaries revealed the remains of 4 workers, 40 drones and some robber-flies. Reliable observations show, however, that this bird merely kills the bees, dropping them beneath the perch. Upward of 60 bees an hour have been recorded as crushed by a single bird.* Not as formerly supposed, the kingbird in numbers is a serious enemy to the apiarist.

Toads sometimes take a few bees about the entrances of the hives. The remedy for this is to raise the hive a few inches from the ground, and provide a generous alighting board.

IMPROVED STOCK.

In bee keeping, as in other lines of husbandry, in addition to intelligent care, "*improved stock*" is the watchword of success. We have already seen that the dangers connected with the bee moth, with robbing and even with wintering may be reduced to a minimum by attention to this point. Most of the difficulty of handling "cross" bees may be met in the same way; and this is no small matter with beginners, amateurs, and those who keep bees in towns or cities.

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* For details of these valuable observations, see "American Bee Journal," Vol. XLIV., No. 36, p. 622, Sept. 8, 1904.

For nearly fifty years the United States Department of Agriculture has been searching the world over to discover superior races of bees, and has imported and tested a number of them. As a result, we now have the following races (except *Apis dorsata*), the comparative advantages of which may be seen at a glance from the table given below. Ten indicates highest excellence and so on down.

*Comparative Value of Different Races of Bees.**

RACE.	Gentleness.	Honey Gathering.	Resistance to Bee Moth.	Wintering.	Prolificness.	Swarming.	Length of Tongue.	Total Points.
Black, .	5	6	4	8	5	6	6	40
Italian, .	8	8	8	6	7	8	8	53
Carniolan,	9	8	8	10	9	10	8	62
Cyprian, .	7	10	10	7	10	8	10	62
Dorsata,† .	7	8	?	?	8	¾	10	33 ?
Caucasian,	10	8	8	8	9	8	?	51 ?

From the rating in the table we see that probably no one would keep black bees, if he knew better. Further than this, any one who keeps black bees in a locality endangers the purity of his neighbor's stock. In most sections of the State this constitutes the greatest difficulty connected with the maintenance of pure high-grade bees, since the black bees are likely to produce great numbers of drones, which mate with the virgin queens of other races. The hybrids resulting from this cross are sometimes vigorous bees and good workers, but are likely to be the meanest bees to handle that we have. The practical impossibility of controlling the moth where black bees are kept should alone suffice to relegate this race to the backwoods.

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* See "Nature study and life," Ginn & Co., 1902, p. 241. This table gives Professor Frank's latest rating, including also the Caucasian race, under date July 17, 1904.

† This is *Apis dorsata*, Fab., the giant honey bee of East India. All attempts to import it having failed, little is known concerning its relative value. It builds huge combs five or six feet in length and three or four feet wide, attached to overhanging ledges or to branches of lofty trees.

The Italian bees have been popular since their introduction in 1860. They are a large, light-colored bee, readily distinguished from the black by having at least the first three bands of the abdomen yellow or leather-colored. They are quiet and gentle, and hence easily manipulated. They cling to the combs when these are lifted from the hive, and thus the queen may be readily found at any time. In resistance to bee moths, prolificness, honey production and other valuable qualities, the Italian bees are seen to be far superior to the blacks. The race has so long almost monopolized the attention of progressive apiarists, that a number of superior strains have been produced by careful breeding and selection.

The Carniolan bees were imported from the Alpine province of Carniola in 1884. They are large, ashy-gray bees, with silvery white hairs, very beautiful and gentle. Professor Benton calls them "ladies' bees," and they are especially recommended to beginners or children. Carniolans cap their honey extremely white; they winter best of any race; they do not tolerate the moth in their hives; they are industrious, working especially well on late flowers; and they are very prolific. About the only questionable quality of the Carniolans is said to be their excessive swarming, but this may be largely controlled by proper shading and by giving plenty of room in the hives.

The Cyprian bees, introduced from the island of Cyprus, are a small, slender bee, with three bands of the abdomen yellow above, and all the segments, often to the tip of the abdomen, yellow underneath. They are industrious and energetic, and hold the record over all other races for honey production, 1,000 pounds having been secured from a single swarm (spring count) in a season. They may often be observed actively at work while other bees are "loafing." It is said that they never molest any one passing or working among the hives unless the hive itself is disturbed, when they become the fiercest and most persistent of fighters. They protect their hives better than other races from bee moths, robber bees and all other intruders; but on this account they have gained a reputation for viciousness in handling, which, from my own experience with stock obtained directly of Mr. Benton, I think they do not deserve. They were easily reduced to subjection with smoke, and could often be handled without it. In point of prolificness, the Cyprians are truly phenomenal. My experience with a single swarm does not permit me to speak in general terms, but I introduced the queen in a very weak colony in June, and by the middle of July it had become a veritable volcano of bees, swarming daily and persistently, in spite of cutting out of queen cells and the removal of numerous extra queens. A large amount of honey was evidently produced, but it was practically all used for rearing bees, and no surplus was obtained from this colony. At present writing I cannot recommend Cyprian bees for Massachusetts, but further experiment may change this opinion.

With regard to the newly introduced Caucasian bees, Mr. Benton writes, under date of July 6, 1904: "I feel pretty safe in calling the Caucasians a valuable addition to our races of bees. They are industrious, prolific, and the gentlest of any bees with which I am familiar, not even excepting the Carniolans. They have wintered successfully in comparison to other races in the latitude of Denver, Col., and have not here [Washington, D. C.] shown themselves inferior in wintering qualities to ordinary strains of Italians. We may thus hope for good reports in the near future."

Much attention is now being devoted to discovering or breeding a strain of bees with tongues long enough to reach the nectar in the flower tubes of red clover. In 1900 the A. I. Root Company offered a prize for the bees having the longest tongues. This was awarded to Mr. J. P. Moore of Morgan, Ky., whose bees were found to have tongues measuring $\frac{28}{100}$ of an inch in length. (Ordinary bees measure but $\frac{16}{100}$.) This length of tongue enables the bees to secure nectar from most of the flower tubes of red clover, and thus to fill their hives with honey that common bees cannot reach. Cross fertilization of the red clover by these bees is likely to prove an important item, for which we are now dependent upon the bumblebees. The problem of "red clover bees" is certainly worthy of attention on the part of Massachusetts apiarists.

In order to put bee culture on a secure footing in Massachusetts, we need first of all a live and united association, which shall reach practically every one who keeps bees in the State. The purpose of such an organization will be to stamp out brood diseases and keep them out of the State, then to work hard for a few years to secure the general adoption of modern methods and the maintenance of improved stock. This should place the industry beyond the reach of the bee moth, at least. The association may find it necessary also to secure adequate legislation for protection of the industry. Another need of the State is a model plant at Amherst, and a strong course in practical apiculture. This, which we are glad to note has already made a beginning, should grow to be the co-ordinating head and the strong right arm of the association. It should become the centre in the State for needed instruction, for proper inspection and development of the industry, for all manner of investigation and experiment; and, possibly, a depot for distribution of the best obtainable stock.

While our subject is not, possibly, a cheerful one, still, to be forewarned is to be forearmed. Most popular writings present the subject in all its most rosy lights, and this ought to be so; for no other branch of industry has the charm, the fascinating and absorbing interest which keeps people young and happy, and tingles in the blood like a veritable fever of delight, when once a mastery of the difficulties of successful bee culture has been attained. And we have thus briefly presented some of its chief dangers and difficulties, in the hope that more people may come to enjoy its many "pleasures and profits."

SPECIAL REPORT

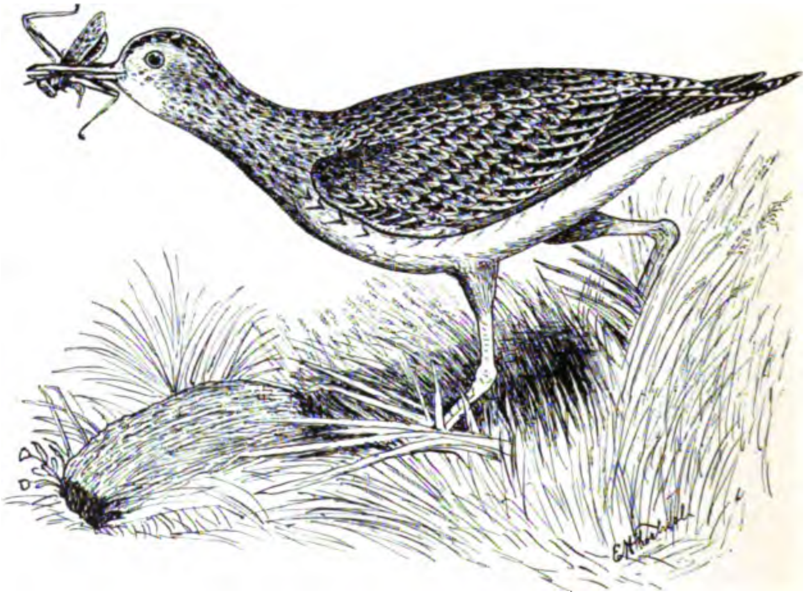
ON THE

DECREASE OF CERTAIN BIRDS, AND ITS CAUSES, WITH SUGGESTIONS FOR BIRD PROTECTION.

BY

EDWARD HOWE FORBUSH.

PREPARED UNDER THE DIRECTION OF THE MASSACHUSETTS STATE BOARD OF AGRICULTURE.



THE BARTRAMIAN SANDPIPER OR UPLAND PLOVER.
A Useful Bird, now in Danger of Extermination.

UNIV. OF MICH.

THE DECREASE OF CERTAIN BIRDS, AND ITS CAUSES, WITH SUGGESTIONS FOR BIRD PROTECTION.

BY EDWARD HOWE FORBUSH, ORNITHOLOGIST TO THE BOARD.

In the pursuit of an inquiry regarding the destruction of birds by the elements, which was authorized by this Board in 1903, some evidence was obtained relating to a decrease in the number of birds from other causes. It was asserted by correspondents that the extermination of certain species was already imminent, and that many others were rapidly decreasing in numbers. The secretary of the Board, upon being informed of this evidence, authorized an investigation of the alleged decrease and threatened extirpation of useful birds, with a view to determine what species had suffered most, and whether it would be practicable to furnish them better protection. Four hundred circulars requesting information were prepared and sent out in July. They were mailed to naturalists, officers of the Audubon Society, correspondents of the Board of Agriculture, secretaries of game protective associations, taxidermists, officers of the Massachusetts Commissioners on Fisheries and Game, sportsmen, market hunters, principals of academies, and intelligent observers generally.

It was intended to compile the evidence, when received, into the form of a bulletin; but this proved impracticable, on account of the vast amount of material returned in answer to the inquiry. It was finally decided to prepare a special report on the subject.

Some of the circulars returned contained little information, but two hundred and seventeen of them furnished data of more or less value. Several correspondents sent excellent annotated local lists. About one hundred letters also were received. Most of the reports and letters were from Massachusetts, representing every county of the State, but a few came from other States. A list of observers and correspondents is appended to this report.

THE DESTRUCTION OF BIRDS BY THE ELEMENTS.

The unusual weather of 1903–04 was the evident cause of a recent scarcity of certain species mentioned in many cases by correspondents. This additional evidence of the effects of the June storms of 1903, or of the winter of 1903–04, will be presented (1) as a sequel to the report of last year, and (2) in order that the results produced by the elements in less than two years may not be confounded with those effected by other and more continuous destructive forces.

In glancing over the reports for 1904, it becomes evident at once that the destruction of eggs and nestlings by the June storms of 1903 caused no great noticeable and generally observed decrease of many species in 1904. This may be accounted for in part by the fact (1) that some of the species affected rear more than one brood in a season, and so were able to bring up young either before or after the storms; and in part by the theory (2) that a large share of the young birds reared each season never return from their southern journey, but succumb to accidents and fatalities on the way; therefore a great mortality among the nestlings of one season may not have a very noticeable effect the succeeding year.

Trained observers, however, noted in their localities a marked decrease of certain breeding warblers, chimney swifts and swallows, although a few reported swifts and swallows as common or abundant. On some of the meadows overflowed in 1903 red-winged blackbirds and marsh wrens were much reduced. Long-billed marsh wrens have nearly disappeared from certain meadows where they were formerly common. Bobolinks, orioles and vireos are mentioned particularly as scarce locally the past season. Night hawks and whip-poor-wills have disappeared from some localities. Mr. Thomas M. Burney of Lynn reports a 75 per cent decrease in warblers. Mr. Rufus H. Carr of Brockton reports breeding black-and-white warblers, prairie warblers and redstarts in about half their usual numbers, martins gone, swifts comparatively scarce, and the barn swallow the only swallow commonly seen.

Most of the common birds appeared in about their usual numbers in the migrations, but no considerable flight of the warblers, which nest mainly north of Massachusetts, was reported. As in 1903, these warblers were again comparatively scarce in their migrations. The flight seemed very light in Bristol, Plymouth and Middlesex counties, where I watched it. Mr. Louis Cabot reports warblers as uncommon at North-east Harbor, Me., but common at Grand River, Can. This is a typical report; but some few observers report birds generally as more numerous than in 1903. Mr. Outram Bangs tells me that in Wareham, where, he believes, all the tree swallows were killed by the storms in 1903, the nesting-boxes were occupied again in 1904 by this species, probably by newcomers. Chimney swifts are reported quite generally as absent, rare or reduced in numbers. Mr. Geo. E. Whitehead of Millbury records that "upward of five hundred" dead swifts were taken from a factory chimney in that town in 1903; and that during the season of 1904 he watched a large chimney formerly frequented by many swifts, and never saw one enter it. In my own experience, in parts of Bristol, Plymouth and Middlesex counties swifts were either much reduced or rare locally throughout the season until the flight in August, when they were seen in numbers in some localities. At that time, one afternoon, I saw about thirty birds in Billerica, which were more than I had seen elsewhere; but the next morning only one was seen. Messrs. William Brewster and Ralph Hoffman report swifts as common in Cambridge and Belmont respectively.

The birds had a good breeding season in 1904, and probably most species will soon recover from the check they received by the June storms of 1903, except, perhaps, the purple martins, which seem to have been almost absent from Massachusetts in the breeding season of 1904. Martins were looked for in April as usual. A few birds were reported, unusually early, from six localities. These were thought to be some of the breeding birds which had escaped the catastrophe of 1903; but so far as can be learned, they all disappeared. Their probable fate may be inferred from the story of Mrs. Frank H. Watson of Concord.

Mr. Watson has two large bird-houses which have been well filled with martins for years, but, apparently, the birds all died during the storms of June, 1903. Mrs. Watson says that two pairs of martins came to the boxes earlier in April, 1904, than usual, but were not seen during, or after, the cold wave and snowstorm which followed the 19th, when some five inches of snow fell. Later, Mr. Watson examined the bird-houses, and found three of the birds dead within.

Twenty-six observers from the different counties of Massachusetts report martins as having disappeared; three report them as nearly extinct; five, as rare; eight, as rare and decreasing; one, "as usual." In response to letters of inquiry sent out later to these and others, it was learned that nearly all the reports referred to migrating birds. Further extensive correspondence leads to the belief that we have no fully authenticated record of the breeding of the purple martin in Massachusetts this season, except in five localities. Mr. Robert O. Morris speaks of four small colonies in or near Springfield, which are still in existence, but one of these has decreased one-half in numbers. Miss Emily B. Adams, also of Springfield, speaks of two colonies, probably some of the same, but says the birds are being gradually driven from their boxes by the English sparrows. Mr. F. H. Mosher writes from Shawmut post-office in New Bedford that a single pair of birds reared their young there. Mrs. Mary R. Stanley of North Attleborough, in the same county, and near the Rhode Island line, says the martins are nearly extinct there, but are still breeding at West Attleborough, where her brother saw two birds feeding their young. Col. John E. Thayer says martins are still breeding at Lancaster; and Mr. William Holden states that a few pairs of birds occupied, and probably bred in, one bird-house in Leominster. Capt. A. B. C. Dakin of Concord states that a single pair of martins were resident at a neighbor's bird-house, but failed to raise any young. This may be accounted for by the fact that the English sparrows, which are notorious for killing young martins, occupied the same domicile. Mr. Fred. C. Dodge says that martins, which arrived ten days later than usual, occupied a small nesting-box near his house in Beverly, and thinks they probably bred.

We have records, therefore, of martins breeding in but three counties in the State, — Hampden, Bristol and Worcester, — with the probability that they bred in Essex County.

What prospect is there that the species will eventually increase in numbers, and reoccupy its old breeding places? It seems probable (1) that some martins may have survived and bred in places not reached by this inquiry; the few birds left may form the nuclei of new martin colonies. Probably also (2) martins breeding in parts of northern New England, and migrating through Massachusetts, may, in time, overflow into this State. (3) Martins are said to be breeding still in Connecticut, New Hampshire and Rhode Island, not far from the Massachusetts line; and there is some probability that these colonies may spread over our borders, although their numbers are much reduced. Mr. Robert Curtiss of Stratford, Conn., where martins were abundant in the spring of 1903, says that only one was seen there in 1904; but Mrs. Mabel Osgood Wright says they are still breeding at Stamford. Mr. Morris reports that martins are numerous at Windsor Locks, Conn., about twelve miles south of Springfield, Mass., and, as numbers of them probably migrate up the Connecticut valley, the repopulation of Massachusetts by martins may be expected to progress as rapidly there as anywhere. It seems to be believed, however, by most careful observers that the martins were diminishing in Massachusetts before 1903. For this decrease the English sparrow was largely responsible. The sparrows are now occupying most of the boxes where the martins formerly dwelt, and, when firmly intrenched therein, they may be able to prevent the martins from retaking the boxes. On the other hand, the decrease of martins and swallows is likely to be followed by an increase of the insects on which they feed. This will probably attract these birds into the State, and favor their breeding; but, unless boxes are generally put up for the martins, and the English sparrows kept out, the martins may never again become common in Massachusetts. The June storms of 1903 will long be remembered as the chief cause of the passing of these beautiful and useful birds.

The effect of the hard winter of 1903–04 upon our resident birds seems not to have been very serious except with a few species. The bob-white, or quail, has been nearly exterminated over much of the State. The ruffed grouse, or partridge, although considerably reduced in many sections, appears to have bred well in the western half of the State in 1904, and has done well locally in the eastern counties. Many dead blue jays were found during the winter, and in some sections jays, crows and chickadees seem to have been much reduced in numbers, but this is by no means universal. I found jays somewhat reduced in Wareham, but crows had increased. Both crows and jays were considerably reduced in Concord, while chickadees were not so common as usual in either place. Some reports from south-eastern Massachusetts indicate a scarcity of flickers and meadow larks, but this is seldom noticed elsewhere. Screech owls suffered severely, and were driven by stress of weather into barns and dove-cotes, where they fed on mice and doves. Mr. A. M. Frazar, the Boston taxidermist, informs me that he had about forty of these birds brought to him, most of which had been taken in dove-cotes. Some were picked up dead. He also received about twenty Acadian or saw-whet owls, that were found dead either in the streets of Boston or in the country districts. Many observers report a recent scarcity of screech owls, while others report them as numerous. My own notes show them to have been rather rare in 1904 where in 1903 they were quite common. Superintendent Charles P. Price of the Middlesex Fells Reservation found several barred owls apparently frozen to death during the winter; they were fat, and therefore had not starved.

Evidently the bob-white suffered more than any other bird from the hard winter of 1903–04; but as many have been introduced since by the Massachusetts Fish and Game Protective Association, and others were carried through the winter by feeding, there are birds enough now to restock the State, if they can be protected.

It is fair to conclude, therefore, that, excepting, perhaps, the purple martin, no species has suffered a lasting or permanent check from the action of the elements in 1903 or 1904.

THE EARLY ABUNDANCE OF BIRDS IN MASSACHUSETTS.

No investigation into the decrease of birds and its causes can be conducted intelligently without some knowledge of the relative abundance of the different families of birds at the time of the first settlement of the country. Had we any full and trustworthy account of the animals of New England, from the pen of some naturalist of the seventeenth century, we could better understand the changes that have occurred in the bird fauna of New England since the discovery of the country. As it is, we must derive our information from the brief, fragmentary and rather unsatisfactory accounts written by some of the early voyagers and settlers. We shall learn little of the smaller land birds of the country from these narratives; but all agree that there was "greate store" of water birds, "sea fowle" and game birds.

From Archer's relation of "Captaine Gosnol's voyage to the north part of Virginia," made in 1602, we learn that the "penguin" (great auk) was found on our shores. This bird evidently was once abundant at certain points on the coast. Early historians refer to birds now extirpated from this region as then existing in great numbers. Swans, cranes, wild turkeys, snow geese, passenger pigeons and other birds, now either rare or extinct here, were then found in great abundance. There were also then, as now, "divers sorts of singing birds whose notes salute the ears of travellers with an harmonious discord."

Capt. John Smith credits the land with an incredible abundance of fish, fowl, wild fruits and good timber. Francis Higginson writes: "Fowls of the aire are plentiful here. Here are likewise aboundance of turkies often killed in the woods. — This country doth abound with wild geese, wild duckes, and other sea fowle, that a great part of the winter the planters have eaten nothing but roastmeat of divers fowles which they have killed."*

Josselyn writes that he has known "twelve score and more of sanderlins" to be killed at two shots.†

Morton says there was "greate store" of swans in the Merrimack River at their seasons, also "greate store" of cranes in the country. He also speaks of two Indians having seen a thousand turkeys in less than a day in the woods.‡ William Woods speaks of the turkeys as being in flocks of forty, sixty and one hundred birds. He says the settlers shot, for their own use, those which went by their doors. He speaks of vast flocks of wild pigeons passing over where he was, and of "seeing neyther the beginning nor ending, length or breadth of these Millions of Millions. The shouting of the people, the rattling of gunnes and the pelting of small shotte could not drive them out of their course and so they continued for four or five houres together." He describes great flights of Brant, gray geese, white geese and wild ducks; and says the gray geese stayed all winter in these waters, while the others were seen only in spring and fall. He asserts that some have killed a hundred geese in a week, and fifty ducks or forty teal at a shot. The "humilities" or "simplicities" as he calls them, referring to shore birds, large and small, could be driven in a herd like sheep, and shot "at a fit time," after which the living would settle again among the dead. "I myself," he says, "have killed twelve score at two shootes."

Morton says that he has often had one thousand geese before the muzzle of his gun, and that the feathers of the geese he had killed in a short time paid for all the powder and shot he would use in a year. He speaks of seeing forty "partridges" in one tree and sixty "quail" in another. Undoubtedly these were the same species that are now generally known in Massachusetts by these vernacular names.

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* "New England's plantation," by Francis Higginson, p. 11.

† "Account of two voyages to New England," 1638-63, by J. Josselyn.

‡ Morton's "New English Canaan," p. 74.

Geese were fed to the dogs and pigeons to the hogs; but, notwithstanding the great waste of bird-life, no appreciable effect on the abundance of the birds was noticed during the first years of settlement, for Woods says that, in spite of the shooting and the "frighting of the fowle" . . . "I have seene more, living and dead, the last yeare than I have done in former yeares." *

THE DECREASE OF BIRDS IN PAST CENTURIES.

The great auk soon disappeared. The great cranes, both brown and white, birds of the open country, were annihilated by the settler's rifle. The Canada goose, which was once found in the State throughout the year, and probably bred about the inland ponds and marshes, was driven out, and became a mere migrant in spring and fall. The wild turkey and heath hen were hunted away to the deep woods; but geese, ducks, shore birds, passenger pigeons and ruffed grouse still existed in abundance until the early part of the nineteenth century.

An old gentleman named Greenwood, a responsible man, who was once keeper of the Ipswich Light, told me in 1876 that in the early part of the century (I have no memorandum of the date) he, with his father and brothers, had to get oxen and sled to haul home the birds, mainly geese and ducks, which they had killed in one day about Thanksgiving time near the mouth of the Ipswich River.

Dwight tells us, in 1821,† that there were then hardly any wild animals remaining besides a few small species; that wild turkeys had greatly lessened in numbers, and in the most populous parts of the country were not very often seen; that grouse were not common, but that water-fowl still existed in great abundance.

This brief glance at two centuries of the history of Mas-

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* William Woods' "New England's prospect," from which this was taken, was first printed in London in 1634.

† Dwight's "Travels in New England and New York," 1821, Vol. I., pp. 52-55. The grouse spoken of here is probably the heath hen, as Dwight and other writers mention this bird as the grouse or pheasant, — a bird distinct from the partridge, or ruffed grouse, and never as common.

sachusetts game birds and their destruction brings us to a time within the memory of a few persons now living, and almost within the scope of the present inquiry.

In the first volume of the "Memorial History of Boston," published in 1880, Dr. J. A. Allen, one of the most eminent of American naturalists, writes of the birds of eastern Massachusetts as follows: "The great auk, the Labrador duck, and five or six other species, have long since disappeared from southern New England. All the larger species and many of the shore birds have greatly decreased, as have likewise most of the smaller forest birds. The few that haunt cultivated grounds have doubtless nearly maintained their former abundance."

In 1898, Director William T. Hornaday, of the New York Zoölogical Park, made an inquiry into the decrease of birds and mammals in the United States. He estimated, from reports received by him from naturalists in many parts of the country, that birds had decreased on the average 46 per cent in thirty States and Territories within the fifteen years then just past, while their reduction in Massachusetts was estimated at 27 per cent. This report has been widely quoted, and very generally credited by the public.

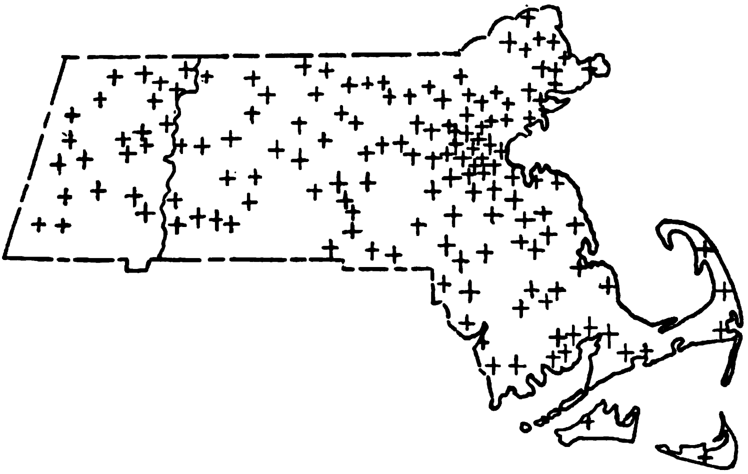
THE DIFFICULTY OF ACQUIRING ACCURATE INFORMATION.

It is difficult to get accurate information as to the increase or decrease of bird-life in a region so large as the State of Massachusetts. A conclusion one way or the other cannot safely be formed by any individual unaided, except in regard to a limited territory with which he has been familiar for a series of years. Such a conclusion, when formed, is merely an opinion, and the personal equation inevitably comes in to bias it. Some people are naturally optimistic, and their reports show it; or they have recently begun to study birds, and see more of them now than in former years. Others are pessimistic, or have become imbued with the popular belief that our birds are rapidly being exterminated. Some are elderly people, who do not, perhaps, see nor hear so clearly as in their youth, and are not so much afield, and so do not notice so many birds as in their younger days.

Some reports come from closely populated regions, where many causes operate to destroy or drive out the birds; others come from more sparsely peopled regions, where the birds and their natural enemies are not so much interfered with. These personal or environmental differences tend to produce contradictory reports. Where there is conflicting testimony, it must be carefully weighed, and all contradictions considered by the one who has to render the final verdict. In this, the evidence of those experts who for years have kept careful notes of the number of birds seen should have the most weight.

A Summary of Reports, by Counties.

Below is a summary, by counties, of the reports regarding the gain or loss in numbers of birds in the State for the past ten to forty years. The questions asked were: —



Map of Massachusetts, marked to show the localities from which reports have been received.

1. Are birds decreasing in your locality, county, or in the State generally?

2. How do their numbers compare with those of ten years ago? Three-fourths as many, one-half, one-third, or do they remain about the same?

3. Has the decrease (if any) been continuing for twenty, thirty or forty years, or longer?

Some correspondents failed to answer these questions, and others answered rather indefinitely. The definite answers received are tabulated below. Seventy-three of those who regard birds generally as diminishing in numbers estimate the percentage of decrease as follows: one, 10 per cent; one, 12½ per cent; twenty-one, 25 per cent; one, 30 per cent; six, 33⅓ per cent; thirty-three, 50 per cent; five, 66⅔ per cent; three, 75 per cent; two, 90 per cent. Eleven state that birds are decreasing somewhat, but give no estimate of the percentage; those also who regard birds in general as increasing give no percentages. It is impossible, therefore, with the figures at hand, to arrive at the average *opinion* as to the percentage of decrease of the birds in the State, to say nothing of the *facts* in the case. To get at even an approximation of the facts, other methods must be employed.

The table shows that a large share of the reports were pessimistic, and on its face, perhaps, presents a darker picture than the facts will warrant.

A Tabulated Statement, by Counties, of the Reports regarding the Decrease of Birds.

COUNTY.	Number reporting that Birds are decreasing.	Number reporting that Birds are holding their Own.	Number reporting that Game Birds are decreasing and Song Birds increasing or holding their Own.	Number reporting Birds increasing.
Berkshire, ...	9	1	3	–
Hampshire, ...	6	4	1	–
Hampden, ...	8	6	1	1
Franklin, ...	3	5	1	–
Worcester, ...	20	8	2	1
Middlesex, ...	17	6	4	5
Essex, ...	12	4	4	2
Norfolk, ...	5	4	1	1
Suffolk, ...	4	1	–	1
Barnstable, ...	2	–	–	–
Plymouth, ...	5	2	1	2
Bristol, ...	3	6	1	1
Dukes, ...	–	1	–	–
Nantucket, ...	–	–	1	–
Total for State, .	94	48	20	14

It will be seen by the above table that ninety-four correspondents report birds as decreasing; only sixty-two report them as either holding their own or increasing. If we add to this number, however, the twenty who regard game birds or other larger species as diminishing, and song birds or the smaller species as stationary or increasing, we shall have eighty-two who believe that the smaller species are either stationary or increasing, against ninety-four who believe all birds are decreasing. Next, we find that forty-three who report birds as rapidly diminishing live in or near the larger cities, where the principal causes of this diminution are most active. There are, then, only fifty-one persons, outside of the influence of the cities, who find birds generally decreasing, to eighty-two who find the smaller birds at least holding their own. This being the case, it seems probable that the smaller birds in general have not decreased greatly in Massachusetts, as a whole, in recent years, except in and near the centres of population. Undoubtedly there are fluctuations in the numbers of certain species over large areas. There are also local fluctuations in the numbers of most species. Certain birds will be rare in a locality for a year or two, and then, perhaps, plentiful again. The reports plainly show such oscillations; but it may be doubted if there is any great and general decrease in all the smaller species.

Mr. Hornaday, by pursuing a similar method of inquiry six years ago, arrived at a somewhat different conclusion. How can this discrepancy be explained? In the first place, Mr. Hornaday apparently based his Massachusetts report on the statements of only eleven people, as against those of two hundred who have responded to the present inquiry. In the second place, seven out of his eleven correspondents lived in or near cities, where birds were, or had been, decreasing.

But it may be said that the testimony taken by him was more in the nature of selected expert evidence than that obtained in the present inquiry. To meet this objection, extracts from thirty-five reports have been selected. These observers may be said to belong to the same class as those from whom Mr. Hornaday received his information. The names of three of his correspondents appear in this list. Circulars were sent to the other eight, but they failed to return them.

EXPERT EVIDENCE.

Nantucket County. — Mr. George H. Mackay of Boston, well known as an authority on Massachusetts sea-fowl, wild-fowl and shore birds, who is very familiar with Nantucket, says that shore birds generally are decreasing; some species have fallen off from 66 per cent to 98 per cent in sixty years. Other species have not decreased so much, or remain about the same. He has noticed no general decrease among the smaller land birds.

Bristol County. — Mr. F. H. Mosher of Dartmouth reports that some species are decreasing, others remain about the same, and a few seem to be increasing. He says the decrease of certain species has been progressing for at least twenty years. Mr. Arthur C. Bent of Taunton says that, generally speaking, birds are not materially decreasing. In some few cases they are, but the numbers remain about the same as a whole. Mr. Elisha Slade of Somerset says that in his locality practically all native species are decreasing. The decrease has been continuing spasmodically, he says, for forty years. He estimates the falling off of certain species within thirty years as follows: quail, ruffed grouse, herons and nighthawks, 50 per cent; mourning doves, purple martins and house wrens, 75 per cent; bank swallows, barn swallows, flickers, swifts, warblers and thrushes, 30 per cent.

Plymouth County. — Mr. Arthur Curtis Dyke of Bridgewater reports some species as certainly decreasing. Among these he mentions, mainly, swallows, birds of prey, game birds and wild-fowl. Mr. Rufus H. Carr of Brockton says: "Not appreciably decreasing, except certain species. Game birds and herons, one-third; hawks and owls, one-fourth."

Norfolk County. — Mr. Henry B. Bigelow of Cohasset says: "I believe that birds are decreasing only slightly in this locality. There is a great yearly variation in numbers. A great decrease in shore birds and water-fowl took place about five years ago." Mr. Frank Blake Webster of Hyde Park writes: "I see no decrease in twenty years. Woodcock seem scarce." Mr. I. Chester Horton of Canton believes that quail, grouse, screech owls, purple martins, house wrens, barn swallows, whip-poor-wills and indigo birds are diminishing, while bluebirds are increasing. Mr. R. M. Baldwin of Wellesley Hills writes that in Wellesley there is a marked decrease in larger birds, a possible increase in the smaller. Mr. F. H. Kennard of Brookline says: "In Brookline they are decreasing; swallows driven out by building up of town."

Suffolk County.—Mr. Homer Lane Bigelow of Boston says that from 1889 to 1897 there was an annual decrease, but since then, with exceptions (*i.e.*, 1903), there has been a gradual increase. Mr. F. H. Allen of Boston expresses a disbelief in any general decrease in the number of birds in the region he is best acquainted with, although certain species are driven out of their accustomed haunts by the extension of city influences into the country, the cutting down of woods, etc. Mr. C. S. Day of Boston, who is also acquainted with conditions in Chathamport, Barnstable County, says birds are decreasing. "I should judge about one-half. I have noticed the decrease particularly the last fifteen years." Hawks, owls, the swallow family, game birds, the house wren, the swift and shore birds are the birds most particularly mentioned as decreasing.

Essex County.—Mr. F. C. Dodge of Beverly says that in the last three years there has been an increase, previous to that a decrease. He says there are not so many birds in the city as formerly, but about the same number in the nearby country. (All observers but one from Beverly report some increase in birds there.) Mr. Reginald C. Robbins of Boston states that, in Essex County, wilderness birds only are decreasing; suburban birds remain about the same; others fast decreasing locally, but holding their own in favorable spots. Mr. J. A. Farley says: "Speaking from ten years' experience in certain towns in southern Essex County, should say, on the whole, birds remain about the same; horned owls, sharp-shinned hawks and red-tailed hawks are a good deal reduced." Dr. Charles W. Townsend, from twenty-eight years' experience, mainly in two towns in Essex County, concludes that shore birds have decreased considerably; but, notwithstanding smaller birds have decreased about the cities, they are holding their own very well in the country.

Middlesex County. — Mr. C. J. Maynard of Newtonville, a field naturalist of many years' experience, says: "Many species have decreased at least one-half. Some hold their own. A few have considerably increased. Excepting in a few species, I do not see much decrease in the last ten years. Swallows are going fast." Mr. Ralph Hoffman of Belmont writes: "The larger birds (hawks, herons, grouse) are decreasing; the smaller birds are about the same. Grouse no longer occur." Mr. Philip T. Coolidge of Watertown writes: "Some species are decreasing. Fully three-fourths as many birds as ten years ago. Bob-whites, hawks, the larger owls, ducks, shore birds, gulls and terns suffer much from shooting." Mr. E. F. Holden of Melrose says: "Birds have decreased within ten years, also within two years; perhaps three-fourths as many as ten years ago, possibly less." Mr. William Brewster of Cambridge and Concord, the leading ornithologist of New England, who has been afield much for the past forty years, says: "Birds do not appear to be decreasing generally, but there has been a decrease among swallows, martins, nighthawks, game birds, birds of prey, certain water-fowl and waders. I should say that the decrease in woodcock, partridges, wood ducks, certain other of the ducks and many of the waders (plover, sandpipers, etc.) had been continuing ever since I can remember, or upwards of forty years." Mr. C. E. Bailey of North Billerica says that birds are much reduced in numbers in his locality. Miss Elizabeth S. Hill of Groton, who has kept a careful annual record, says that some birds are increasing and some decreasing, but that for the past ten years the per cent of increase is the larger. Her list shows that the principal decrease is found among the herons, ducks and birds of prey; the increase is mainly among the smaller species.

Worcester County. — Dr. C. F. Hodge of Worcester reports birds as increasing rapidly on his premises, and he believes there are more in the city than three or four years ago. Dr. Hodge is a professor in Clark University, and a leader in nature study at Worcester. He takes a careful bird census each year, destroys the English sparrows and other enemies of birds, puts up bird-houses, feeds birds, and teaches the children not to molest them, — all of which may account for the increase of birds in his vicinity. Mr. William S. Perry of Worcester, who has had a long experience as a field ornithologist, sportsman and teacher, and who is familiar with many towns in northern Worcester County, says: "Some species have remained about the same for the last thirty years; others are exterminated; others are decreased one-half. Most show decrease, some increase." Dr. Lemuel F. Woodward of Worcester, whose observations have extended over more than thirty years, believes that hawks, owls, eagles, game birds, nighthawks, swallows, warblers and thrushes are decreasing. Col. John E. Thayer of Lancaster writes that he has been in the woods nearly every day between March 15 and July 1 for the past eight years. He says that, with the exception of four species, birds have not decreased in his locality. Mr. Charles E. Ingalls of East Templeton, who has had a large experience as a field observer, and has travelled much about the State, says that birds are decreasing in his town, county and State. He says a gradual decrease has been apparent for thirty or more years, accelerated during the last ten years. Mr. C. E. Stone of Lunenburg believes that insectivorous birds are rather on the increase. "A few species, notably the game birds, are not as plentiful as formerly."

Hampshire County. — I have received no report from any ornithologist in this county, so present the reports of observers in whose judgment I have confidence. Prof. Wm. P. Brooks of Amherst writes: "Should say birds are not decreasing in this vicinity." Dr. H. T. Fernald, also of Amherst, having consulted with Prof. R. F. Nelligan in regard to game birds, believes there is some decrease, but assigns the weather as one cause.

Hampden County. — Mr. Robert O. Morris of Springfield says that, generally, birds are not decreasing in his vicinity. He speaks of a decrease in owls, hawks and herons. Mr. F. H. Scott of Westfield thinks birds are not decreasing there. "Some years ago a scarcity of some of the smaller birds was apparent; recently there has been an increase among many."

Berkshire County. — Mr. J. M. Van Huyck of Lee thinks birds are decreasing, but the decrease is assigned mainly to the larger species; the smaller species seemingly are on the increase. Hawks, owls, eagles, game birds and herons have decreased much, according to his observations.

On the whole, the above-mentioned observers apparently have not seen a great decrease in the numbers of the smaller birds except in the case of a few species; but the older observers record a considerable diminution within forty to sixty years among game birds, water-fowl and shore birds.

My own experience as a resident of the suburbs of Worcester and Boston, if taken alone, might lead me to believe that the smaller native birds have fallen off much within the last thirty years throughout the State, as they certainly have in those cities; but in many of the country districts I find the majority of the smaller species still in nearly the same numbers as thirty years ago. I do not find small birds as numerous in Plymouth and Bristol counties, or in sections of Middlesex County, as they were in Worcester County thirty years ago. The fertile soil of Worcester, one of the richest agricultural counties in the world, supports more birds to the acre than the sandy soil of Plymouth and Bristol counties, or the gravelly hills of some parts of Middlesex. The large number of cities in eastern Massachusetts, with their ever-increasing population flooding the surrounding country, must have had a seriously restrictive effect on the bird-life of this section. No one will question the fact that the sum of bird-life must have been somewhat reduced in this region by the growth and expansion of the cities, and the destructive and repellent forces which radiate from them into the surrounding country; but, outside of a certain radius from each city, the conditions of bird-life still remain much the same (for most of the smaller species) as they were in much of the city itself forty years ago. This may be illustrated by the experience of Dr. L. F. Woodward of Worcester. He says: "I am confining my observations of bird-life to two localities: first, my home in the centre of the city of Worcester; second, the grounds and adjacent country about the Quinsigamond Boat Club at Lake Quinsigamond. First, the city. Thirty years ago, robins, catbirds, tree swallows, chipping sparrows, vireos and summer warblers built in our garden; now, nothing builds about the site of the house but the robins and chipping sparrows. For three years no young robins have been raised in our yard. The sparrows either destroy the nests, or the cats get the birds. The chimney swifts, which formerly were fairly abundant about the site, are very much diminished, also the nighthawk. Second, at the Quinsigamond boat club grounds the English sparrows were absolutely exterminated three years ago, and are not a factor in bird-life in that particular region. The birds as a whole have become rather more numerous and much tamer than formerly. The white-breasted swallows, having abundant house accommodation, have increased, but this year have rather decreased. The chimney swifts, once quite numerous, were reduced this year to three individuals. Locally, the thrasher, veery and chewink have increased, as has also the field sparrow. The whip-poor-will, common up to three years ago, has practically disappeared; and the king-bird, of which we have always had several pairs, has not appeared on our grounds this year. The grackles have markedly increased about the lake, while the red-wings have diminished. The purple martin disappeared from the city of Worcester, so far as I know, a year ago. I have talked with several good observers, none of whom has seen a single individual of this species this year. The mourning dove probably nested at the lake this year, as I have seen individuals occasionally during the spring and summer. This is the first time I have seen this bird for nearly twenty years. The spotted sandpiper has diminished. All birds have been protected from sparrows and cats, but not from grackles, crows, blue jays and other wild birds. I should say that numerically the birds were holding their own in that particular locality, but that individual species fluctuated, some years particular birds being numerous, while others which seem to be subjected to about the same perils are rare."

As an epitome of bird-life, and the contrasting conditions affecting it in the city and country, Dr. Woodward's report is noteworthy. The main causes of the decrease of birds in the city are exhibited, and the reduction of the birds in the city with their comparative abundance in the near-by country is made plain. In the one case the birds were subjected to city influences; in the other they were protected from them, and given opportunity for breeding. The results in the latter case are obvious. A notable effect of the June storms of 1903 is apparent in the diminution of tree swallows, the extermination of the martins, and, possibly, also in the decrease of the whip-poor-wills, red-wings and kingbirds. The fluctuations of species from year to year may be owing to natural causes operative everywhere, or to the malign influences emanating from the city not far away. He offers no explanation, but states the facts. They form the text for a treatise on bird protection.

In the development of our civilization there have been evolved or introduced certain influences destructive to bird-life, such as trolley cars, improved firearms and the English sparrow. Taking such forces into consideration, together with the growth of cities, it is possible, perhaps, that we now have fewer of the smaller native birds in the State than forty years ago. Many of the larger species have been decreasing steadily. Along the coasts and in the densely populated regions, game birds, many shore birds and some water-fowl have lessened to such an extent that they are evidently doomed to extermination, unless better protected. So far I must agree with those who believe that our birds are being extirpated. But we must guard against too much pessimism. It is quite natural to remember the times in our youth when birds were very numerous, and forget the seasons when they were comparatively few. So one remembers the cold winters and severe snowstorms of his childhood, and forgets the mild seasons. Similarly it seems, as we look back, that we had many tremendous flights of warblers in those days, but the records show very few.

Mr. Abbot H. Thayer of Monadnock, N. H., where many of the repressive forces which exist in eastern Massachusetts are almost unknown, who takes a very optimistic view of the matter, says that asking the public, or even so-called ornithologists, whether they find birds diminished, is as deceptive in its results as a look at the telegraph poles along a road. Just where the observer stands there is one pole or none, while a glance back down the road reveals a massed accumulation one against another, — all due to perspective. One's past, he says, is so well stocked with so many remembered sights of rare and beautiful birds that only a very philosophical mind can escape the impression that birds were formerly constantly in sight, whereas one really saw few in some seasons, as is the case to-day.

Lest the conditions in Massachusetts regarding the smaller birds might prove exceptional, and the results of the investigation misleading, the inquiry has been extended somewhat into other populous States of the Atlantic seaboard. The reports seem to indicate that with some exceptions the smaller birds are not generally decreasing in numbers in those States. Extracts from reports of some of the most competent observers are given below.

Mr. C. J. Pennock, ornithologist to the Pennsylvania State Board of Agriculture, says that birds are probably decreasing, but not to any great extent, except a few species. He mentions the dickcissel, purple martin, ruffed grouse and bob-white as species that have been decreasing for many years, and the house wren as increasing in his locality (Kennet Square, Pa.).

Mr. Frank M. Chapman, assistant curator of the department of birds in the American Museum of Natural History, writes from his home, Englewood, N. J.: "Birds remain about the same, except bobolinks, which have been exterminated locally; the larger hawks and owls, which decrease with the disappearance of the woodland; game birds, including doves and wild fowl; eave or cliff swallows, which have disappeared locally as breeders; and tree swallows, which are possibly less abundant as migrants."

President Theodore Roosevelt, who is an accurate observer of animal life, writes from his home on Long Island, N. Y.: "Here at Oyster Bay my observations have gone over thirty-one years. During that time I do not believe there has been any diminution in the number of birds, as a whole. Quail and woodcock are not as plentiful as they were; I am inclined to think that last winter may have been hard on quail around here. But, on the other hand, there are one or two other wild birds that, I think, have increased in numbers." Later he wrote, in response to an inquiry regarding the shore birds: "During my time there have never been any but scattering shore birds in my neighborhood on the north shore of Long Island, and there are now as many of these as there ever were. During the same period there has been a great diminution in the shore birds, once so plentiful, in the Great South Bay on the south shore of Long Island; as I happen to know, because my uncle lives there."

Mrs. Mabel Osgood Wright of Fairfield, Conn., says that, speaking locally for Fairfield and ten miles inland, some species have decreased, others have held their own. The great horned owl is nearly extinct. Wood ducks have become very rare within ten years; also mourning doves; scarlet tanagers and shore birds in general have decreased.

Mr. E. Hart Geer, secretary of the Connecticut Commission of Fisheries and Game, writes that shore birds have decreased greatly, and that river ducks have decreased every year. He says there was as good a flight during the fall of 1904 as was consistent with the "extermination due to unrestricted shooting."

Mr. Harry Hathaway writes from Providence, R. I.: "The shore birds, game birds, hawks and owls are decreasing in the State generally, but no appreciable decrease is occurring in other species, and some few species are increasing in numbers." He says that a fair estimate of the decrease of the birds named would be one-half in fifteen years, but that this may be too large, as his observations have been "locally restricted." Hawks and owls have been driven off, he says, by the removal of their nesting sites. This was very evident after the coal strike in the spring of 1902, when much wood was cut. A law passed by the Legislature, offering a bounty on hawks, owls and crows, also has had some effect.

Mr. Abbot H. Thayer of Monadnock, N. H., writes: "Ever since Hornaday's announcement I have done my best to know the truth about this region. Now, nearly fifty years later than when I first knew Keene, N. H., every wet spot has the same red-winged blackbirds, . . . every mowing its bobolinks, and all the village birds are as abundant in a general way as forty-eight years ago. . . . I believe that the only species that have suffered any significant change are the passenger pigeon, upland plover and wood duck; also the ruffed grouse and the bobolink (as I am told, not as I notice here)." The upland plover he regards as nearing extinction, and the purple martin as occupying fewer bird-houses than formerly.

Dr. G. H. Perkins of the University of Vermont, entomologist of the Vermont State Experiment Station, Burlington, writes: "I think, on the contrary, many birds are increasing. Birds are well protected, and I think few are intentionally killed in the State. I should say there has been no decrease, as a whole. Going back fifty years ago, if accounts are to be trusted, the wild pigeon and some others were more abundant than of late. Swallows, swifts, song sparrows, robins, bluebirds, redstarts, vireos, white-crowned sparrows, bobolinks, many warblers, meadowlarks, downy and hairy woodpeckers and creepers do not seem to decrease, if not increasing."

Mrs. Elizabeth B. Davenport of Brattleboro, Vt., says that birds are not decreasing, as a whole. Grouse are reported less in number, the martins are decimated and the house wrens are sadly decreasing.

It is fair to conclude, from all the foregoing, that with the smaller species the natural balance of bird-life is now fairly constant in Massachusetts and the neighboring States, and that the decrease will be found mainly among those species that are most hunted.

It now remains to take up separately those families of birds which are reported as diminishing in Massachusetts, that we may see what species most need protection. While it is difficult to get accurate reports regarding birds as a whole, those regarding particular species are more readily obtained. Such reports are the more valuable, as they indicate just where protection is needed.

BIRDS REPORTED AS DIMINISHING IN NUMBERS.

Family Podicipidæ. — Grebes.

This includes the birds commonly known as dippers, water witches, etc. This family and the one following seem to be of comparatively little economic importance so far as the farmer is concerned, as the birds composing them get their food almost entirely from the water. The pied-billed grebe undoubtedly once bred in suitable places about the inland bodies of water in this State; it is now known to breed in very few localities east of the Connecticut River. It has been driven away from at least three localities in Massachusetts in the last few years. It is still fairly common in the migrations on many of the ponds and rivers in the interior of the State, but seems to have decreased greatly on the rivers of eastern Massachusetts, where, although its flesh is of little value, it is pursued and shot whenever it appears. This grebe might have been able to dive quickly enough (at the flash) to escape the charge of the flint-lock gun, but with the modern breech loader at close range it has no chance. The horned grebe also probably once bred here, but is now seldom seen except in migrations or in the winter. Along the coasts the grebes are quite well able to take care of themselves, and, as they now breed mainly far to the north, where they are little disturbed by man, our three species seem about as common as ever on the coast in their migrations.

Family Gavidæ. — Loons.

Loons, no doubt, once bred commonly in the more retired ponds over a great part of the State. Thirty years ago they were not rare in the breeding season in the northern part of Worcester County, where they were observed to nest at different localities by Messrs. C. E. Ingalls and C. E. Bailey. I am not aware that they now nest anywhere in the State. No doubt they would have been driven from the interior of the State long ago, had they not been well able to take care of themselves by diving. They are still to be seen in the migrations in most of the larger and more remote bodies of water, and seem to maintain their numbers along the coast, as does also the red-throated loon.

Family Laridæ. — *Gulls and Terns.*

Certain of these birds were once very abundant in the breeding season on Long Island Sound, and bred also in suitable islands all along the Massachusetts coast. Miss Katharine P. Loring of Prides Crossing, Beverly, writes that about forty years ago there were large numbers of "gulls" in spring at Gooseberry Island and Eagle Island off the Beverly shore, and that these islands were "covered with their eggs." The birds referred to were probably terns, or "mackerel gulls," as they are called locally. The Arctic and roseate terns are both recorded as breeding at Beverly and Ipswich as late as 1846 and 1869 respectively.* These terns, together with the common and least terns and the laughing gull, bred abundantly along our coast as late as the early part of the nineteenth century. They were gradually driven off the breeding grounds by eggers. In the decade before 1890 the demand for the plumage of gulls and terns for millinery purposes became so great that they were menaced with extermination. Mr. Geo. H. Mackay says that he has been informed that one party of gunners killed no less than ten thousand of these birds on Muskeeget Island in one year. Since then Mr. Mackay, who was for years a member of the committee on bird protection of the American Ornithologists' Union, has succeeded in securing protection for the birds breeding on this and other islands, as a result of which they have increased enormously. He says that they are now more abundant than at any time for many years. The least tern, or sea swallow, however, which was formerly abundant, but was one of the chief victims of the milliners, has not, he says, shared in this increase, and is now comparatively rare. The herring gull probably once bred here, and still breeds on the Maine coast. This bird is as wary as a crow while here, and, if protected on its breeding grounds, it is likely to maintain its full numbers. It is seen here now mainly in fall, winter and spring. Probably no sea birds other than the laughing gull and the terns above mentioned now breed in Massachusetts, although gannets, cormorants and other species are seen along the coasts in migration.

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* "Birds of Massachusetts," Howe and Allen, p. 27.

Family Anatidæ.—Ducks, Geese and Swans.

This family contains a large number of beautiful and graceful birds, known generally as wild-fowl or water-fowl. They form collectively one of the most valuable natural assets of any country. Many species are unexcelled as food, and, if properly protected, they will continue an annual source of food or income to a considerable proportion of the rural population. Their presence on the waters or in their peculiar flight-formations adds a certain charm to any landscape. Their sonorous cries and calls speak of the freedom of the wilderness. Were they extinct, how we should miss the call of the wild geese in the spring, and the sight of their wedge-shaped flocks sweeping across the sky! Yet we are strenuously endeavoring to extirpate them. The wild swans are gone; only a few wanderers have been recorded as shot in the State during the last quarter of the past century; their occurrence here now may be regarded as merely accidental.

The Geese (Subfamily Anserinæ).—The lesser snow goose is probably the white goose that was once so abundant in Massachusetts Bay and on Cape Cod, according to the tales of the early settlers. It is now so rare as to be regarded as merely an accidental visitor, and I am not aware of any very recent capture of this bird in Massachusetts.

The Canada goose, although still a common migrant, has decreased in numbers within my recollection. Mr. Elbridge Gerry of Stoneham, who has been a market-hunter for nearly seventy years, says there were a hundred geese in his boyhood days to one now; and yet he believes that more are being killed now than ever before, on account of the use of trained live decoys. This bird, though once breeding here, now breeds mainly north of the United States. According to Mr. William Brewster, it is now protected on its breeding grounds on the island of Anticosti. This island, some forty miles in length, is studded with numerous ponds, where the geese can now breed unmolested. This protection, together with the extreme wariness the birds have acquired, may account in part for their having held their numbers so well in their flights along our coast for the last twenty years. Fifty to seventy years ago the geese often flew very low over the country, and sometimes they alighted in pastures and corn fields; now they usually fly high, and seldom alight except on some sheet of water. Mr. Mackay believes that the Canada geese are not now decreasing at Nantucket.

The Brant goose, which was once remarkably abundant all along our shores, was very common some seasons in migration at Chatham and some other points on Cape Cod up to the latter part of the last century, but rare elsewhere. I am informed by Mr. Elbridge Gerry that Brant are now rare even there, in comparison with their former numbers.

These are probably the only three species of geese that were ever abundant in Massachusetts.

The Bay and Sea Ducks (*Subfamily Fuligulinæ*). — Ducks are divided into three subfamilies, bay and sea ducks, river and pond ducks, and mergansers or sheldrakes.

The first subfamily, the bay and sea ducks, is composed of birds that find their food by diving. These birds breed mainly in the far north, where, excepting the eiders, they are not much molested. They can usually keep well away from the shore, and can escape the gunner by diving and swimming under water, as well as by flight. Most of them are not highly esteemed as food, on account of their fishy flavor, and for these reasons they have on the whole maintained their numbers better than any other ducks. One species, however, the ruddy duck, which habitually feeds in small ponds near the sea, has decreased very rapidly of late. They once bred in Massachusetts. Thirty years ago they were very common migrants; now they are seldom seen. In 1878 I found them abundant in Florida; in 1899 I did not see a single bird there, though it was a good season for ducks of all kinds. They are now the object of special persecution, and have been for twenty years or more. Their price in the market has quadrupled. Unless something effective is done for their protection, they are likely to follow the species already extirpated. The scoters or surf ducks, called coots by the gunners, although perhaps decreasing slightly, appear to be nearly as abundant as they have been within the memory of people now living. Mr. Gerry says they are nearly as plentiful as ever along the coast; Mr. Mackay has studied the sea birds, wild-fowl and shore birds for many years. He has visited the Boston markets at least twice each week during the season, and carefully noted what birds were on sale there. He has spent much time on Nantucket and the adjacent islands, both in the shooting and breeding seasons. His opinion on this subject is therefore of the greatest value. He says that surf ducks and eider ducks seem to hold their own generally, especially about Nantucket. He believes the white-winged scoter has diminished very little. The American scoter he has never known to be plentiful, but apparently it has decreased to some extent.

The old squaw is still very common, and no decrease is noted by any one. Mr. Mackay regards it as very abundant. The bufflehead is still common along the coast, but has been driven out to some extent from many ponds and rivers in the interior, where it is not so common as formerly in the migrations. The golden-eye or whistler is also still common on the coast.

The greater scaup duck, blackhead or bluebill was once very abundant in Massachusetts waters. The scaup decreased rapidly off the Massachusetts coast, until they became rather rare a few years ago. Mr. Mackay, however, says they are now becoming common at Nantucket, and Mr. Hoffman rates them as common migrants.*

The lesser scaup, raft duck, little blackhead, or bluebill, as it is known among the gunners, was once one of the most abundant of all ducks along the Atlantic seaboard. Ranging to middle or southern Florida in winter, it is exposed to the gunners all along the coast. It has decreased more than some other bay ducks, — perhaps for this reason. I found it in northern Florida in 1878, the most abundant water-fowl I have ever seen. At that time great "rafts" of these ducks, at least a mile in length, were seen on Indian River. When a boat approached one of these great masses of birds, those nearest the boat would rise and fly over the flock, making one continuous roar of wings as the boat approached. While crossing Lake George on a steamer, the remarkable spectacle was witnessed of a sheet of water dotted all over with these ducks as far as the eye could see. In 1899 in the same region there were still some large flocks, but I estimated that the birds had diminished fully 75 per cent. The lesser scaup is now growing rare in this State. Redheads and canvasbacks have never been recorded as generally common in Massachusetts. Mr. Mackay says that more redheads were seen at Nantucket in the winter of 1903–04 than for many years.

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* "A guide to the birds of New England and New York," Ralph Hoffman, p. 299.

The Pond and River Ducks (*Subfamily Anatinæ*). — Mr. Hoffman says: "Seven species belonging to this division occur regularly in eastern New York and New England. All but one, however, are now so rare that the ordinary observer will hardly come across them."* This is indeed true in regard to Massachusetts. In the course of this inquiry only one observer reported these ducks as holding their own; all others reported them as decreasing. These birds may be distinguished from the bay and sea ducks by the fact that they do not dive for their food, but take their food from the bottom in shallow water by putting their heads under. They are more distinctly fresh-water ducks than the bay and sea ducks, and are more exposed to the gunners by reason of their feeding in shallow water and usually near shore. No doubt our ponds, marshes and streams once swarmed with these ducks during the migrations, and it is not improbable that some of them bred here, as the wood duck and black duck still do to some extent.

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* "A guide to the birds of New England and New York," Ralph Hoffman, p. 301.

The wood duck, the most beautiful of all ducks, once bred abundantly throughout New England. In Massachusetts it has been growing rarer near the coast for years, but has been fairly common in parts of most of the inland counties until the latter part of the last century. In this inquiry no questions were asked regarding the wood duck, but information comes from Berkshire, Worcester, Essex, Middlesex, Norfolk, Plymouth and Bristol counties that this bird is rapidly decreasing, or gone. Fourteen observers speak of the bird as follows: extinct, three; nearing extinction, five; decreasing, three; decreasing until the last two years, one; holding their own, two. Some of these reports come from regions where the wood duck has always been a common bird. In other sections its absence has now ceased to attract notice. My own experience with the wood ducks seems to indicate that they are decreasing rapidly. A few years ago they were occasionally seen in small flocks during the breeding season; this year I saw but one in the migrations at Concord. This bird, a fine male, was comparatively tame, and I might have shot him on three different occasions. He was finally killed by a gunner. This species is not so wary as many other ducks. It often haunts small streams and ponds which can be shot across. Where gunners find a family of these birds, it is not very difficult for them to get every one. Mr. Edwin R. Lewis, one of the bird commissioners of Rhode Island, wrote me from Westerly, on Dec. 19, 1904, that wood ducks had been only occasionally seen that year, and that he knew of only ten of these birds having been killed during the season. In 1901 Dr. A. K. Fisher of the United States Biological Survey predicted that the wood duck and the woodcock would become extinct, unless better protected.* This prediction now seems in a fair way to be realized, so far as wood ducks breeding in Massachusetts are concerned.

The American widgeon or baldpate was formerly seen quite generally in small flocks on the interior waters of New England. It is now believed to be either uncommon, rare, or wanting everywhere in Massachusetts except possibly in the Connecticut valley and along the coast in some seasons; but Mr. Mackay regards it as not uncommon on Nantucket.

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* "Two vanishing game birds," A. K. Fisher, Year Book of the Department of Agriculture for 1901, published in 1902.

The black duck has fallen off very much in numbers, but it is the only river duck that still may be regarded as generally common in the State. Mr. Gerry says that the number of black ducks seen now is about one-tenth of one per cent of the number that were here seventy years ago, and that they have been decreasing ever since that time. He says he killed sixty-six black ducks in two mornings in Spot Pond, Stoneham, about fifteen years ago, and that the ducks there are increasing now under the protection of the Metropolitan Park Commission, but that in the ponds outside of the park there are practically no ducks now. Black ducks leave the salt water at night, going to the springs for fresh water when the ground is frozen. They have been greatly decreased by night-shooting, but they have now become very shy, and usually hide in the reedy sloughs, or, when in ponds or on salt water, keep well away from the shore during the day. There seems to have been a slight increase of these birds within a year, and a good flight in some sections in the fall of 1904.

The mallard has been generally rare in the State for many years. Mr. Arthur Curtis Dyke of Bridgewater regards it now as being, next to the black duck, the most common there. Mr. Lewis reports an increase of mallards in 1904 in Rhode Island. The shoveler is very rare, and the gadwall also rare, although said to have been once not uncommon. The pintail may now be considered a rare bird in most of Massachusetts, where within thirty-five years it was commonly seen in small flocks. The blue-winged teal was a common migrant in the State up to within thirty years, being found in large flocks in the small ponds and streams. Mr. Gerry says that fifteen to forty years ago he killed blue-winged teal nearly every morning, in the season, at Spot Pond, which is only about seven or eight miles from Boston. He has seen about two hundred birds in a flock at Plymouth, and has been informed that a boy killed eighty-four in one day within twenty years at Sandwich. Now the teal are nearly all gone, although there was a small flight in the fall of 1904. In September a flock of fourteen birds passed me three times on the Concord River. They were fired at several times, and that was the last I saw of them. I have not seen so many in a flock for years. Occasionally a small flight like this is seen in the fall, but very few ever come back in the spring. Mr. Mackay says that until 1904 probably not forty blue-winged teal have been seen on Nantucket in fifteen years.

Green-winged teal, Mr. Gerry says, were formerly very plentiful, but he has not seen one now for five years. In 1870 my predecessor, Mr. E. A. Samuels, regarded this bird as "quite abundant" * in the spring and autumn migrations in New England. Now it is rare, and seems to be going out. I have not seen one in Massachusetts for years. Mr. Mackay says it was formerly common but is now very rare.

The Mergansers (*Subfamily Merginæ*).—The mergansers, sheldrakes or fish ducks are still not uncommon, the red-breasted merganser being abundant off the coast in the migrations. These birds are expert divers, breed far north, and most of them do not go far south. They are well able to take care of themselves. The American merganser, goosander or pond sheldrake was formerly very common on ponds and rivers, and once bred in the State. It is still common in winter along the Connecticut. The hooded merganser, once, like the wood duck, very common, is growing rare, and is now the rarest of the mergansers.

Family Ardeidæ. — Herons.

It seems probable that herons are decreasing in many localities. Thirty-five persons report them as decreasing, twelve report them as unchanged in numbers, and five state that night herons are increasing. My own experience, together with that of others in whose judgment I have great confidence, seems to indicate that, in general, these birds are not now decreasing rapidly. The law passed in 1904 giving them protection was no doubt necessary to their preservation, as their size alone dooms them to constant persecution.

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* "Birds of New England," E. A. Samuels, p. 493.

The least bittern keeps very closely hidden in the meadows or swamps and is seldom seen by the ordinary observer. While it probably has been driven out of many localities by the draining of meadows, I hear its note in suitable places quite as often as I did when a boy.

The green heron has grown less common where boys or foreigners do much shooting; elsewhere it probably does not vary much in numbers, except where the trees or shrubs in which it breeds are cut away. In the localities which I have frequented this year, however, it has been less common than usual.

The American bittern was driven out of many of its breeding places last year. Breeding birds have disappeared from a certain locality in Wareham where they were formerly seen. This was probably due to shooting. On the other hand, they were more common along the river in Concord this year than last. On the whole, the bittern seems to be holding its own fairly well, excepting near the cities.

The great blue heron no doubt formerly bred abundantly in some localities in Massachusetts. In September, 1874, I saw what seemed to be a nest of this species in North Brookfield; but I know of no recent record of its breeding in the State, and it was probably driven out long ago.* It visits us regularly in the migrations, and takes care of itself so well that few except immature birds are shot. In my own experience this species has not diminished greatly of late, but I saw fewer birds this year than last. Many other observers, however, are very positive that the great blue heron is steadily diminishing in numbers, despite the law recently enacted protecting all herons at all times in Massachusetts. Mr. Gerry says they are few along the coast, in comparison with the numbers formerly seen. About thirty years ago he saw between thirty and forty at once feeding at Wellfleet.

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* Since the above was written I have been told by Mr. J. A. Farley that a single nest of this species has been found recently in the State by Mr. C. E. Bailey.

The black-crowned night heron has certainly been driven out from three inland localities where I formerly knew it to breed. The birds were persecuted by egg-hunters and gunners, so that they were forced to change their breeding grounds nearly every year; and finally they were killed or scattered, so that these heronries exist only as memories of the past. The birds have persisted, however, along the coast, and some of their heronries are now protected. All other herons besides those mentioned above are regarded as accidental in Massachusetts.

Family Rallidæ. — *Rails, Gallinules and Coots.*

These birds, particularly the rails, are rather secretive, and ordinarily are seldom seen in this region. Their habits protect them. The gallinules are not known ever to have been common. The coots, the least secretive of the family, probably have decreased, while the rails seem to hold their own except where driven out by floods or the draining of meadows. They are probably overlooked by most gunners. Only a few observers report on them at all; these find them about the same as ever, except Mr. Edward A. Bangs, who says: "On occasional trips to the Sudbury marshes at Wayland it seems to me that the ducks, rails, herons, etc., have almost disappeared."

Order Limicolæ.

Shore Birds. — Only twelve of the forty-two species of shore birds known to inhabit the State or migrate through it can now be regarded as at all common. Three species are uncommon; fourteen, rare; and the rest merely accidental or casual. Most of those now considered common were formerly very abundant, as were also some which are now rare. Nearly all the larger species are now either uncommon, rare or casual. Some of them are nearly extirpated or driven off our coasts. A few of the accidental species never were common here, but the others probably were. The common smaller species have been saved from total destruction, some by their small size, which makes shooting them of little profit, and some by not consorting together in large flocks. For these reasons mainly, perhaps, the "peeps" or smaller sandpipers, the smaller plovers and the spotted and solitary sandpipers now seem to hold their own very well, although the "peeps" and sanderlings were once very much more abundant than now. Turnstones are still not uncommon, both in spring and fall. The black-bellied plover, or beetlehead, a bird formerly migrating along our coast in enormous numbers, has decreased rapidly since the middle of the last century. In 1842 three men shot one hundred and twenty-one birds May 24, and one hundred and fifty May 25, on Tuckernuck Island. In 1870 a law was passed prohibiting the shooting of these birds in the spring migrations. The law was repealed in 1871, but afterward re-enacted, and since then the species has increased somewhat. Mr. Mackay says that never for the last fifteen years have there been so many of these birds as during the past two seasons, — 1903 and 1904; and that there is now a notable increase of young birds each fall. The golden plover has not benefited much by this law. The abundance of the Eskimo curlew and the golden plover is largely governed by the amount of spring shooting done in the Mississippi valley, as most of these birds come north by that route. "The golden plover is now practically eliminated from the east," says Mr. Mackay. This was once one of the most abundant of our migrating birds, coming at times in enormous flights, and fairly glutting the markets. Mr. Henry Shaw tells me that at one time, probably soon after 1860, a great flight of these birds swarmed over the fields south of Worcester, and that practically every man and boy in the place who could get a gun was out shooting them. There is no record of a single bird having been killed there since. Mr. Mackay says that only about a dozen golden plover were seen in the Boston market in 1904, up to September 16.

The killdeer plover is said by old gunners to have been common once on the coast, and occasionally plentiful in the interior and along the Connecticut River. Several observers confirm this. It was once not rare in some portions of Worcester County, and common in Berkshire County; it is now rare everywhere, so far as I can learn.

The long-billed curlew, or sicklebill, the largest of the curlews, has not been common in migrations on the Massachusetts coast within the memory of old gunners. It is now merely casual. Mr. Mackay refers to it as follows: "Only rare stragglers left, less than half a dozen having been taken in Massachusetts in twenty years. Very few left in South Carolina, where they were formerly very abundant."

The Hudsonian or jack curlew was a very abundant species sixty-five or seventy years ago. "On Nantucket and Tuckernuck they were then shy, as now. They gradually decreased until about fifteen years ago. After that about one hundred and fifty birds appeared annually in July and remained through the summer. A few are killed each year, but the numbers remain about the same. They are the most common curlew now on Nantucket. They are much fewer now in the Boston market than in former years." (Mackay.)

The Eskimo curlew, or doughbird, was once an abundant migrant. This curlew is the most highly esteemed by epicures of all shore birds; for this reason it has been hunted incessantly whenever it appears. "About 1872 there was a great flight of these birds on Cape Cod and Nantucket; they were everywhere. Enormous numbers were killed. They could be bought of boys at six cents apiece. Two men killed three hundred dollars' worth of these birds at that time." (Gerry.) "Eskimo curlew, once common, have not been seen on Nantucket or brought into the Boston market as taken in Massachusetts (except an occasional bird) for a number of years." (Mackay.) "Almost extinct." (C. L. Perkins, Newburyport.) These birds are either nearly extinct in the east, or are avoiding our coasts in the migrations. Mr. Mackay says that the Eskimo curlew and the golden plover have dropped off 90 per cent in fifty years, and that in the last ten years 90 per cent of the remaining birds have disappeared. These two species almost invariably migrate together, and so are subject to equal decimation from gunners.

The Hudsonian godwit, or "goose bird," as it was called by the Massachusetts gunners, was once perhaps as abundant as any of the larger shore birds on the coast. "This bird was as plentiful as any bird I ever saw at Ipswich sixty years ago. I have not seen one now for about thirty years." (Gerry.) It is now growing very rare, and, together with the marbled godwit, a famous bird of the olden time, is seldom seen now on our coast. "Practically none left of either species." (Mackay.)

Vast flights of the knot, or red-breasted sandpiper, used to roam this coast. Fifty years ago this bird was very abundant. "Now fallen off 98 per cent, and the red-breasted snipe or dowitcher is nearly in the same category." (Mackay.) "I have seen the redbreast at Orleans flying in clouds. My father killed two hundred in one day in 1848 at Nauset Harbor. I have not seen a bird now in fifteen years in the same places. The marsh snipe (dowitcher) used to be very plentiful at Ipswich and Wellfleet. I have not seen one for ten years." (Gerry.)

Previous to 1850, when the Cape Cod railroad was completed only to Sandwich, the knot was still a very abundant bird at Chatham, Nauset, Wellfleet and Billingsgate, Cape Cod. At the flats around Tuckernuck and Muskeeget islands they were remarkably numerous. At this time the vicious practice of "fire lighting" prevailed. Two men together, one with a lantern and the other with a bag, would creep on the flocks at night. While one man dazzled the bird's eyes with the lantern, the other caught them, and, biting their necks to kill them, put them into the bag. *Six barrels* of these little birds taken in this manner were seen at one time on the deck of the Cape Cod packet for Boston. Barrels of birds which were spoiled during the voyage were sometimes thrown overboard in Boston harbor. The price of the birds at that time was but ten cents per dozen.*

The willet, or humility, as it is called along shore, one of the great tattlers, was probably one of the birds referred to by the early settlers, under the same name, as flocking on our coasts in vast numbers. "These birds were very plentiful at Wellfleet, and there were a good many at Ipswich, but lately they have been growing rare. I have seen several within five or six years." (Gerry.) "Sixty years ago the willet was abundant, and bred here. Fifteen to eighteen years ago a few were seen each season. Now they are gone; only an occasional straggler now seen." (Mackay.) "Nearly exterminated." (Perkins.)

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* "Observations on the knot," Geo. H. Mackay, Auk, Vol. X, January, 1893, p. 29.

The greater and the lesser yellowlegs are still fairly common in some seasons and localities, but they were once very abundant, and they are probably still decreasing in spite of the protection afforded them on some of their northern breeding grounds. "The lesser yellowlegs have fallen off on Nantucket 60 per cent in fifteen years, and the winter yellowlegs about the same. There also has been a considerable falling off in the number of these birds from Massachusetts sources in the Boston market." (Mackay.) The yellowlegs were the only shore birds reported as common in the flight in Rhode Island in 1904.

The Bartramian sandpiper, commonly known as the upland plover, a bird which formerly bred on grassy hills all over the State, and migrated southward along our coasts in great flocks, is in imminent danger of extirpation. Thirty-five years ago these birds bred commonly within the city limits of Worcester, about Fitchburg and in the country around and between those cities. A few still breed in Worcester and Berkshire counties, on Nantucket, and possibly elsewhere in the State, so that there is still a nucleus, which, if protected, may save the species. Their former abundance is shown by some of the statements of the older gunners. "When I was a boy, nine years old, my father killed ninety upland plover in one day. He killed sixteen without picking one up." (Gerry.) This was about seventy-five years ago, in the days of muzzle-loading guns. "Breeding birds, or those living on Nantucket, have fallen off 66 per cent in the last fifteen years." (Mackay.) "Upland plover extinct here from hunting, but breeds sparingly in northern Worcester County." (W. S. Perry, Worcester.) Five reports from localities where this bird formerly bred give it as nearing extinction, and four as extinct. This is one of the most useful of all birds in grass-land, feeding largely on grasshoppers and cut-worms. It is one of the finest of all birds for the table. An effort should be made at once to save this useful species.

The pectoral sandpiper, or grass bird, formerly wonderfully abundant in the fall migrations on the salt marshes and meadows by the sea, has been common until very recently, and was abundant occasionally up to within about twelve years ago, when I last followed the marsh birds. I have been somewhat surprised to hear from Mr. Mackay that this species is no longer common in migration. He says they seem to have almost disappeared. A few are seen occasionally in bad weather. Mr. Gerry says he has not now seen a good flight for about ten years. He also says that the last really good marsh shooting he had in Massachusetts was about thirty years ago. He left the hotel at Wellfleet at noon in a carriage, accompanied by Mrs. Gerry; he fired twenty-three shots, killed sixty-seven birds, mainly beetle-heads, jack curlews and willets, and was back at the hotel at 4.30 P.M. Mrs. Gerry held the horse and kept tally of the shots fired. There is no difference of opinion in regard to the diminution of the shore birds; the reports from all quarters are the same. It is noteworthy that practically all observers agree that, considering all species, these birds have fallen off about 75 per cent within twenty-five to forty years, and that several species are nearly extirpated.

Snipe and Woodcock. — The Wilson's snipe is one of the most "shot at" birds of the American fauna, and, considering the amount of ammunition that has been expended on it, it has not decreased in numbers so much as might have been expected. Nevertheless, far fewer birds are now seen in Massachusetts in spring and fall than formerly were found in our meadows at those seasons. There is a legend in Concord, told me by Mr. William Brewster, that years ago a certain gunner won, in a few hours, a wager that he could kill fifty snipe with a limited number of shots on the Concord meadows. There is much shooting done there now, but each gunner gets comparatively few birds.

The woodcock formerly bred abundantly in small swamps and alder runs throughout the State. Thirty years ago it bred in all suitable places about Worcester, but within ten years from that time the breeding birds were shot off. Mr. Gerry has kindly lent me a memorandum book kept by his father, Col. E. Gerry, in 1838. He tells me that the woodcock recorded in this book were shot about Stoneham. Colonel Gerry commenced to shoot woodcock in July, therefore the birds shot must have been those breeding in the locality. On July 7 he shot twenty-two, for which he received only two dollars and seventy-five cents; on the 8th he shot and sold forty-two; on the 9th, nine; on the 16th, twenty; on the 21st, six; on the 22d, twelve; on the 23d, fifteen; on the 27th, eight. On the 11th he shot twenty-seven "birds," probably woodcock, by the price. These woodcock were sold in Boston at twelve and one-half to twenty-five cents each. After the first of August the score of woodcock shot falls off rapidly. Here are one hundred sixty-one resident woodcock, young and adult birds, killed by one man close to Boston in July. There were no doubt many other shooters operating about the city. No wonder that breeding woodcock disappeared rapidly from the region near Boston. The woodcock is decreasing all over its range in the east, and needs the most stringent protection. Of thirty-eight Massachusetts reports, thirty-six state that woodcock are decreasing, rare or extinct, while one states that they are holding their own, and one that they are increasing slightly since the law was passed prohibiting their sale. These reports refer mainly to birds breeding in Massachusetts. In the fall of 1904, in a few sections, there was a good flight of birds from the north.*

Family Tetraonidæ. — *Grouse and Partridges.*

Mention already has been made of the bob-white or quail, our only representative of the partridge family, as a sufferer from the effects of the winter of 1903. Another severe winter followed the hunting season of 1904, and the quail now needs more protection. The heath hen, formerly common over much of New England and the middle States, has been extirpated everywhere within the last century except in Martha's Vineyard. Dr. J. A. Allen says that prairie chickens were introduced there,* but, if so, they have probably died out as they have in other places in the east. The heath hen is a hardy bird, and possibly might be propagated, and, under protection, restored to our woodlands.

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* Since the above was written reports of an increase of breeding birds have come in from Worcester and Middlesex counties.

The ruffed grouse, or partridge, the king of all our game birds, has decreased greatly in numbers over most of the State within the last half-century. No doubt there are gunners who kill nearly as many birds now as were killed by individuals fifty years ago, but those who do this do it by covering a great deal more ground than was necessary then, and they are merely bringing the birds nearer to extermination. The decrease is estimated at from 50 to 75 per cent. Forty-six observers report the grouse as diminishing in numbers, three say grouse are holding their own, while only five report an increase. The species is extremely hardy, and, naturally, its increase is affected by only the most severe and unusual inclemencies of the weather.

Family Columbidæ. — Pigeons and Doves.

The wild, or passenger, pigeon, once so abundant here, is now practically extirpated. It is of interest to note a recent report of the occurrence of the passenger pigeon, which seems to be authentic. Mr. Clayton E. Stone of Lunenburg reports seeing a flock of twenty-three birds there on May 6, 1896. Another instance is mentioned in the report of the Massachusetts Fish and Game Commission for 1903.

The mourning dove is reported as decreasing, rare or extinct by thirty-nine observers; a few others report it as wanting in their localities, or as unchanged in numbers. These reports come from every county in the State except Dukes, Nantucket and Franklin, from which no report on this bird has been received. The only cases of increase are reported from Bristol and Worcester counties. Miss Agnes G. Barnes of Plymouth says the species is increasing, after almost total extinction. Miss Abbie Churchill of Fitchburg says the bird has been seen recently "for the first time" at Fitchburg. Col. J. E. Thayer says the doves are increasing at Lancaster, and S. F. Stockwell says they are scarce but increasing at Millbury. I have seen rather more of these birds than usual in Middlesex County this season, but from the reports it seems probable that the species is in some danger of extirpation. As against the encouraging reports from Worcester County, there are eight pessimistic ones from the same county.

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* "Memorial history of Boston," Vol. 1, p. 12.

Family Bubonidæ. — *Horned Owls, etc.*

Thirty observers report owls as decreasing, ten report them as unchanged in numbers, three report an increase. The increase is reported only from Franklin and Berkshire counties. The decrease is most marked in Worcester and the eastern counties, but there are four reports of decrease from Berkshire County.

While the larger owls appear to be decreasing generally in eastern Massachusetts, and breeding great horned owls have disappeared from many sections, the screech owl is still locally common.

Family Falconidæ. — *Eagles and Hawks.*

This family has been long regarded as decreasing in eastern Massachusetts, and the present inquiry confirms that impression. Twenty-eight persons report eagles as decreasing, and most others report them as very rare, or even nearing extinction. Mr. W. R. Stearns of Pittsfield, Berkshire County, however, says that he sees a slight increase in the number of eagles there. The golden eagle is very rare, but has been noted occasionally within twenty years. The bald eagle is not rare at some localities along the coast, especially in Plymouth and Barnstable counties; but old gunners say that it is not nearly so common as years ago.

Hawks are reported as generally decreasing by thirty-seven observers; others report them as rare; seventeen, as in usual numbers; but thirteen note an increase. The reports of increase come mainly from Berkshire, Hampshire and Franklin counties; some come from the outlying towns of Worcester County. Only five observers east of Worcester County see any increase in the number of hawks, and these are from the more remote towns. East from Worcester County thirty-one report a decrease; west from Worcester County six note an increase and four a decrease. The reports seem to indicate that hawks, especially the larger species, while on the whole diminishing in eastern Massachusetts, are at least holding their own generally in the western counties, except perhaps in Berkshire, where the correspondence indicates a falling off in some sections. The reports are not detailed enough to enable many comparisons to be made as to the relative scarcity of the species, but the red-tailed hawk seems to have fallen off as much as any. On the other hand, the red-shouldered hawk, while decreasing locally, seems to be holding its own in many localities, and even occupying more territory than formerly. This seems to indicate that it is, in a measure, taking the place of the redtail in the breeding season in the eastern part of the State, where the former is growing rare. The marsh hawk seems to hold its ground fairly well in south-eastern Massachusetts and also in some other parts of the State.

Family Corvidæ. — Crows and Jays.

Crows are reported to be diminishing by only four observers and increasing by eighteen. Eleven of the latter come from west of Worcester County, which may indicate that crows are increasing somewhat in the western counties, as those making reports from that region are much fewer than those from the eastern part of the State. The blue jay, while decreasing locally, seems generally to hold its own.

Most of the birds, other than those already reported on, are such as are generally included by our law-makers under the head of

Song and Insectivorous Birds.

After careful study of the detailed reports received on many species, it is impossible to escape the belief that certain of the smaller birds have decreased in, or disappeared from, some densely populated regions. It is quite evident that, in some cases, a recent diminution in numbers was caused by the unfavorable weather conditions of 1904, and that, had it not been for this cause, no decrease would have been noted. Wherever enough reports regarding any family or species have been received to warrant drawing conclusions, they will be given.

In regard to the cuckoos, kingfishers and woodpeckers there is not sufficient evidence on which to base anything more than an assumption that they are in general maintaining their former status. The northern flicker, gaffer woodpecker, high-hole, pigeon woodpecker or "wood pigeon," is believed by some to be diminishing rapidly, and this is probably true in some localities, but generally its numbers are being well maintained. Twelve observers report it as diminishing; twenty-four, as holding its own; and twelve, as increasing. Four of the reports showing a decrease are from south-eastern Massachusetts, and the cause attributed is the hard winter of 1903–04. Six of the others came from regions in Middlesex County where the birds probably have decreased from palpable causes.

Family Caprimulgidæ.

The Whip-poor-will and the Nighthawk. — Six reports mention a recent sudden decrease or an absence of the whip-poor-will, which may or may not be a result of the June storms of 1903; but there is much evidence that the nighthawk has been diminishing for years in certain sections. Twenty-four observers report it as diminishing, very rare or absent, where it was formerly common. Seventeen see no change in their localities, but only eight report the bird as increasing or abundant. The decrease is reported from Berkshire, Franklin, Hampshire, Middlesex, Norfolk and Bristol counties, which comprise much the greater part of the State. In Essex County the species seems to be holding its own, or in some cases increasing. We have Barnstable, Nantucket and Dukes counties yet to hear from. In some localities in all parts of the State nighthawks seem to be holding their own; but the evidence of competent observers seems to agree, in the main, with my own experience, — that they are decreasing over large areas. Mr. William Brewster, who has kept careful records of the number of birds seen and heard, says that nighthawks have been decreasing for years in the region about Cambridge and Concord. Mr. C. E. Bailey reports them now as growing rare in those sections with which he is familiar. The evidence from portions of south-eastern Massachusetts, as well as many regions in the western counties, seems to indicate that these birds are now generally rather uncommon there. A large part of Worcester County, however, seems to be well supplied with them. It is impossible to make any accurate statement of the areas in which they have decreased without a careful canvass of the whole State.

The Meadowlark and Bobolink.—It is quite generally believed that the meadowlark and bobolink have diminished because of the early cutting of the grass in fields and meadows since the general introduction of mowing machines. Where the grass is cut in June, the eggs or the young of these birds, even if escaping injury by the machine, are exposed to the heat of the sun and the attacks of their enemies. This inquiry gives some evidence of a decrease of these species, but not so much as might have been expected. Thirty-six observers report meadowlarks as decreasing; eighteen, as unchanged; twenty-three, as increasing. The reports of decrease come mainly from Berkshire, Hampshire, Worcester, Norfolk and Bristol counties. Indications of a recent decrease appear in a portion of Barnstable County. The reports of the birds holding their own come mainly from Middlesex and Franklin counties; while the reports of increase seem to be local and nowhere general, as they are scattered through all the counties except Norfolk, Barnstable, Dukes and Nantucket. All this seems to indicate a general decrease in only Hampshire, Worcester, Norfolk and Bristol counties, and even in these counties it is by no means universal.

Only fourteen reports are made upon the bobolink; twelve report it as decreasing or becoming very rare, and two as increasing. This bird is probably diminishing in Massachusetts, but, as most of the reports are from Middlesex and Worcester counties, it is impossible to tell how general the diminution has become.

Family Hirundinidæ. — *The Swallows.*

Even previous to the injury done by the destructive rain storms of June, 1903, it seems probable that the swallow family was represented by far fewer colonies and individuals in Massachusetts than it was thirty to forty years ago. Many observers have seen a decrease in some species within ten years. Some report a gradual decrease of all species, while comparatively few report an increase, except of the tree swallow. This species was greatly diminished in the winter of 1895 by a cold wave in the south, and since then has been recovering its numbers, which may account for the increase noted locally. Twelve observers report an increase of the bird, eighteen report numbers unchanged, and thirty-two report a decrease. The increase comes mainly in Hampden, Franklin and Berkshire counties. Although some persons in these counties report this swallow to be decreasing, the reports of decrease are distributed generally among all the counties on the mainland.

Eleven observers report an increase of barn swallows, twenty-one report that their numbers are as usual, and forty-one report a decrease. Franklin is the only county in which the reports of increase outnumber those of decrease. In this county also and in Middlesex and Essex counties there are the greatest number of reports that the bird is holding its own. From Middlesex there are nine reports of a decrease, but also eight that the numbers have not changed. Two report an increase. All reports from Suffolk County indicate a decrease, as might be expected from the accession of population; but the same is true of Plymouth County, where there are few cities.

The cliff swallow or eave swallow is reported by only eight observers as increasing, as holding its own by sixteen, and decreasing or extinct by thirty-two. Most of those who find the cliff swallow decreasing agree that this has been going on for twenty to thirty years. This bird was originally a native of the west, where it built its mud nests on cliffs overhanging rivers. Its eastern movement, which began in the time of Audubon (when it followed civilization eastward, nesting under the eaves of the settlers' buildings), ended probably about 1850. At that time these birds had established colonies over a large part of New England, and were very abundant in the farming communities of Massachusetts. Soon after the introduction and spread of the English sparrow they began to decrease, and have diminished until their colonies in the eastern part of Massachusetts are now much fewer than formerly. So many reports have come in of the abandonment of nest sites and so few of the establishment of new colonies that one can only wonder where the birds have gone.

The reports from Plymouth and Bristol counties seem to show that bank swallows are decreasing, as all observers who report at all on this species regard it as diminishing. The reports from the other counties are not so definite, except from Essex County, where they are now said to be increasing.

In my special report published last year the following statement was made: "It has been said that there are no bank swallows in Essex County." * This statement was published on the authority of a friend, who made rather an exhaustive canvass of the county about 1895, and found that the breeding birds had disappeared from all localities where they were formerly known, so far as he could learn. The published statement brought information from three different parts of the county, showing that bank swallows are still breeding there, and increasing rather than diminishing. While the evidence regarding the entire State seems to indicate a rather general decrease of these birds, it is not so convincing as in the case of either the barn or cliff swallows. In looking over all the evidence, it seems as if these two species have decreased most in the eastern part of the State, while the purple martin has, up to 1903, decreased most in the western counties. On the whole, the evidence of competent observers agrees with my own observation, which indicates that breeding swallows have been diminishing gradually for thirty years, although they still hold their own in many localities.

The only other significant or progressive decrease of a

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* "Agriculture of Massachusetts," 1903, p. 479.

species as shown by these reports is that of the house wren. Five observers report an increase, eight report the numbers unchanged, and thirty-eight report the birds as decreasing, becoming extinct, or absent in the breeding season. When it is considered that these reports come mainly from localities where the house wren was once common, their significance is apparent. Thirty or forty years ago the bird was found about many of the cities in Massachusetts; now it is rarely seen. It seems to be decreasing in every county on the mainland. In my own experience this bird has become rare or wanting, within thirty years, in nearly every locality where I once knew it to be common.

There is some evidence that the red-headed woodpecker was common locally at one time. The Rev. T. B. Forbush told me in 1870 that it was common about Westborough, Worcester County, up to about 1830. He knew the bird well, and identified it at sight. Mr. J. M. VanHuyck of Lee, Berkshire County, writes that the red-head was once common there, and that a pair formerly nested in a hole in an old balm-of-gilead tree on his farm. A pair was reported to me as breeding in Worcester County in 1878, but I had no chance to verify this, as both birds were shot by a collector.

The wood thrush is markedly decreasing in some localities, but this is fully made up by its increase in others. Warblers generally appear to be decreasing in Plymouth, Bristol and Barnstable counties and parts of Worcester County, but the decrease may be mainly due to the weather conditions of 1903. Taking the State as a whole, the reports of increase and decrease are quite evenly balanced. The same is true of the thrush family; eighteen report an increase, fourteen no change, and seventeen a decrease.

The rose-breasted grosbeak is reported as increasing in thirteen different localities and as decreasing in only two. From my own experience, and from comparing notes with others, I have come to believe that this bird has been increasing and spreading slowly in Massachusetts for about forty years. It seems now much more common and generally dispersed than it was thirty years ago. It seems to have adapted itself to changing conditions, and has come out of the woods and into the villages more than formerly. Whether the advent and increase of the Colorado potato beetle, on which it feeds, has had anything to do with this, is, perhaps, worth investigating.

Some observers report an increase of the scarlet tanager, but others report a decrease, and the account nearly balances. My own impression is that this bird was not so common thirty years ago as now, but it fluctuates in numbers from year to year. A few species beside the rose-breasted grosbeak evidently are increasing. Forty-four observers report the robin as increasing; four, no change; and seven, decreasing. A similar though less marked increase is reported of the bluebird and song sparrow.

THE CAUSES OF THE DECREASE OF BIRDS.

In considering the causes of bird destruction, as mentioned in these reports and letters, it becomes evident that *man* and his works are of the most importance. Beside man all other destructive forces dwindle into insignificance. The destruction of birds by the elements or by their natural enemies is not to be compared for a moment with that inflicted by man on all species that come within the scope of his wants. Man's persecution is annual and perennial. It gives a species no chance to recover. It seldom stops short of extermination, unless restrained by stringent laws efficiently enforced.

Man the Exterminator.

The reports on the diminution of bird-life, as caused directly or indirectly by man, may be tabulated as follows to show the relative importance of each cause: —

CAUSE.	Number of Observers reporting.
Sportsmen, or "so-called sportsmen,"	82
Italians and other foreigners, ...	70
Cutting off timber and shrubbery, ...	62
Market hunters, ...	57
Bird shooters and trappers, ...	32
Egg collectors, boys and others, ...	32
Milliners' hunters, ...	18
Draining marshes and meadows, ...	17
Gun clubs and hunting contests, ...	16
Telegraph, telephone and other wires, ...	3
Electric or trolley roads, ...	2
Railroads, ...	1
Automobiles, ...	1
Telephones, ...	1

The man "behind the gun" is, of all men, the most destructive to birds. The shooter, therefore, must head the list.

Sportsmen and Market Hunters. — Sportsmen and "so-called sportsmen" are given the chief place as bird destroyers. The number of observers who report them as such is considerably in excess of those who name market hunters. This is rather surprising, until we consider the increase in the number of sportsmen in the past fifty years.

Every city now has its gun club or sportsman's club, and so have some towns. The members practise to obtain proficiency in shooting on the wing. Even the boys have clubs of their own, in some places, where they practise at trap-shooting. Forty years ago there were comparatively few good wing shots. Since the invention of the glass ball and clay pigeon they have become a legion. The number of trained setters, pointers and retrievers also has increased greatly. Mr. H. R. Packard of Attleborough writes that there are at least seventy-five hunters provided with bird dogs now, where there were only three bird dogs in the town thirty years ago. A man who knows very little of the habits of the birds can find birds with a dog. A well-trained dog enables the sportsman to find and follow birds to the death when once started.

The improvement in modern firearms renders the sportsman of to-day far more dangerous to the birds than was his great-grandfather with the uncertain flintlock. In olden times the sportsman must do the best he could with his single shot (when the gun did not miss fire). Then came the percussion cap, the double gun, the breech-loader, the "pump gun," and now we have the rapid-firing automatic gun. With this a passing flock can be followed with a perfect rain of shot. The association of sportsmen into clubs facilitates the general spread of knowledge about favorable covers or stands. No sooner are game birds plentiful anywhere, than the newspapers publish the fact for all the world to read and profit by. Railroads widely advertise all places along their routes where game can be found. Hotel keepers publish the advantages their neighborhoods afford to shooters. The telegraph and telephone carry to the cities the news of the arrival of flights of birds. The railroads, steamboats and trolley cars convey the shooters immediately to the spot.

Let us see how these various agencies work in the destruction of shore birds. A flight of birds is seen some day on the shores of Cape Cod. This news is immediately telephoned to Boston. The favored ones get it, and that night the trains take them to the ground. The next morning they join with the local gunners in what is virtually an attempt to kill every bird. If the daily papers publish the news, every gunner who reads it can take advantage of the opportunity, and be on the ground within twenty-four hours. When the ducks and geese are flying, men go and live in brush houses built at the ponds, or conceal themselves in blinds, or follow the birds in boats. The deadly "pump gun" makes it almost impossible for a flock to get safely by a good shot. In the winter of 1900–01 I observed some modern duck-shooting in Florida. The members of a certain shooting club that had bought a large tract of marshes were accustomed to lie in blinds in favorable localities, where they shot so many ducks that they could not possibly make use of them. These ducks were kindly given away to people who lived in a region within twenty miles of the clubhouse. A sportsman occupying a blind and putting out his decoys would have men in boats to go about and start the ducks, that they might be attracted to his decoys. I am credibly informed that at least one of these gentlemen had several "pump guns" in his blind, with a man to keep them loaded, and, being a very quick and accurate shot, he was able, once at least, to kill in this way over one hundred ducks in less than two hours. Such shooting as this is probably exceptional. It only shows what can be done toward exterminating the birds by the modern sportsman, using modern methods, and without the effort of stirring from his tracks. There are many sportsmen, of course, who will neither practise nor countenance such slaughter; but there are too many gunners who, like the market hunter, are out to kill as many birds as possible. Market hunters are still numerous, but are probably not increasing greatly in numbers, for game is becoming too scarce to make hunting very profitable, even at the high prices now paid; and the law in Massachusetts now (1904) forbids the marketing of the grouse or woodcock. A large proportion of the market hunters are law-abiding citizens, and will not shoot much unless they can sell their birds legally; but there are some who will kill birds at any season, and sell them to epicures, hotels and road houses.

Hunting Contests. — Hunting contests or side hunts are still indulged in by many gun clubs. While these hunts may be conducted within the law, the spirit of the contest is wrong, for each contestant strives to kill as many birds as possible, that his own side may win, and that the other side may pay for the dinner which is to follow. Barrels of birds and game have been killed in these hunts. Nothing tends more to exterminate the birds and game than these contests, and, the contestants being out to kill all they can, some are sure to kill birds other than game birds. All large birds and many small ones suffer. This association of hunters in rivalry to kill game is a blot on the history of civilization. It goes beyond the rapacity of the savage. The native Indians expressed disgust when they first saw the white men engaging in this kind of slaughter. It should be prohibited by law.

Italians and Other Foreigners. — So long as there are shooters, all large birds, whether game birds or not, are doomed to endless persecution, merely because they make good targets. Herons, hawks, owls, eagles and crows are shot at sight, whenever opportunity offers, and those that escape do so only by superior cunning and agility. Some of our hawks and owls are certainly among the most useful of all birds, but this group suffers particularly at the hands of the sportsman or gunner, because some hawks and owls kill some of the game. Farmers and poultrymen shoot them also.

A comparatively new element of danger to the smaller birds, and, for that matter, to all birds, is the fast-increasing horde of foreigners, mainly Italians, who come here from their native lands to engage in contract labor. Most of these men seem to be sportsmen, hunters or trappers in their way, but they regard everything that wears fur or feathers as game. These people go out in small parties, most of them armed with guns, and, in some cases at least, shoot at nearly every living thing they see. I have been told that if so much as a song sparrow gets up, the whole party shoots at it. Some of these gentry came into my yard in Medford in 1895, and shot a pair of bluebirds that were nesting there. The birds are not shot for profit, for their little bodies will not pay for half the ammunition fired at them. They are shot for sport, and it is said they are afterwards eaten. These people also trap and net birds. Several of them have been arrested in the Middlesex Fells Reservation with live birds in baskets, which they had caught by means of twigs covered with bird-lime. Bluebirds, orioles, thrushes, purple finches and bobolinks are favorites with these trappers, who take them for export as cage birds. Most of the birds do not live to reach Europe. Three persons speak of a decrease of purple finches and one of a decrease of bobolinks from this cause. Mr. C. J. Maynard of Newton writes: "The purple finch is fast going. I have not seen over twenty this year. Cause, possibly trapping." He speaks of some cases of trapping which he knew of. As the purple finch seems to be holding its own at a distance from the cities, the inroads made on them by trappers near Boston and other cities in eastern Massachusetts may account for a local decrease there. A good trapper provided with decoy birds will soon have most of the male birds in a neighborhood, and some of the females. This trapping is not wholly confined to foreigners, but no one else seems to use bird-nets.

Mr. Wm. N. Prentiss, a deputy of the Massachusetts Fish and Game Commission, writes from Milford, Worcester County, that one of these people had a net, seventy-five feet long by six feet high, stretched where robins and other small birds came to drink and feed, which had probably "destroyed hundreds of birds," before he was arrested. Italians and Greeks are the people principally complained of. This shooting and trapping by foreigners is general. Complaints on this score came in as follows: from Berkshire County, eight; Hampden, six; Hampshire, two; Franklin, two; Worcester, fourteen; Middlesex, twelve; Essex, nine; Suffolk, four; Plymouth, two; Bristol, two; Norfolk, six; while two report it from the State in general.

This is the greatest danger which now threatens the smaller birds of Massachusetts and several other States. Mr. H. S. Hathaway of Providence, R. I., writes: "This fall there have been numerous complaints of foreigners shooting song birds." Complaints of this sort are coming from most of the Atlantic States. In the South Atlantic and Gulf States, foreigners and natives, especially negroes, shoot small birds in winter for the market. Unless we protect them here on their breeding grounds from this European invasion, their numbers must soon diminish, as has already happened in some parts of Italy and other Mediterranean countries.

Boys with Guns. — Boys with guns are about as destructive to small birds as foreigners. The "air rifles" and other guns, given as premiums by boys' papers, soap manufacturers and others, slay their thousands. Dwight Whiting wrote some years since, in "The Country Gentleman," that one boy's record for his air rifle was four hundred and seventy song birds. Several of his companions had done better than this. They had no use for the birds, and were only shooting for a record. The numerous advertisements of boys' guns show that they meet with a ready and profitable sale. When a boy is out with a gun looking for legitimate game, and does not find it, he will shoot something else; and so long as boys are allowed to carry loaded guns, the small birds are sure to suffer. Very few boys know the game laws. Most of this shooting is illegal, and the boys should be arrested. Miss Juliet Porter writes from Worcester that boys there are shooting English sparrows and other native sparrows, confounding one with the other. Such mistakes will always be made if boys are allowed to carry guns of any kind.

Milliners' Hunters and Taxidermists. — Those who write of milliners' hunters destroying birds seem to refer mainly to the past, as the demand for the plumage of native birds does not now warrant people in taking the risks incurred by breaking the laws to obtain them. This was once a very serious evil in the case of the gulls and terns, and from 1870 to 1880 it was a menace to such birds as orioles, tanagers and bluebirds; but shooting of small birds for this purpose probably never became general enough in Massachusetts to do very serious harm. My correspondence on this subject indicates that very few men are now hunting in this State to supply milliners.

Complaints are made that naturalists or taxidermists shoot the rarer birds. No doubt this is true, but it is usually illegal, as very few persons now have permits for scientific collecting. Whenever such conspicuous birds as the cardinal or mocking bird establish themselves so far outside their usual range as Massachusetts, enthusiastic young naturalists are very likely to secure them. Such shooting possibly may prevent the gradual extension of a bird's range.

The rage for collecting birds' skins and eggs, which was so prevalent among school boys years ago, is believed to be largely a thing of the past. Taxidermists and dealers in birds' eggs generally report a very small demand for birds' eggs and skins. Many of the students are now studying the lives of the birds and following them with the opera glass, instead of the gun. Nevertheless, Mr. T. L. Burney of Lynn says that the kind of nature study taught in many schools results in a tendency to rob birds' nests. He speaks of two boys being arrested for robbing nests, who said their companions were doing the same thing. He also said he met, in the woods, many children who were interested in birds, and said they hoped to get a collection of eggs. Such children usually do not know that this kind of nature study is an infraction of the laws of the Commonwealth, punishable by arrest and fine.

Trolley Roads, Automobiles and Launches. — The cheap transportation from city to country offered by the trolley roads affords hunters, boys and foreigners an opportunity to reach distant fields and woods, and so spreads the baneful influences of the city over a much wider radius than ever before. Foreigners and boys swarm into the country, and practise with their cheap firearms on all animated nature, from the slow-moving turtle and the frog to the farmer's fowls or cattle.

While the poor man takes the trolley car, the well-to-do or rich take the automobile. The automobilist, with the long-range, small-bore rifle, has the advantage over all the others in killing any creature that can be shot while stationary. The "auto," unlike the horse, will stand quietly for the shooter. Farmers say that shooters in "autos" are killing everything of any size within rifle range of the roads. Mr. C. E. Bailey says that he believes they have killed most of the hawks that were formerly to be seen sitting on dead trees along the roads of the country over which he travels.

The gasoline launch is a potent factor in the killing or driving out of the ducks along our coasts and rivers. It is used illegally to get within range of the bay ducks, and its constant use in the rivers of the eastern counties frightens the ducks away from their former haunts.

Telegraph, Telephone and Trolley Wires. — The wires of telegraph, telephone and trolley companies annually cause the death of hundreds if not thousands of birds, which fly against them in the night or even by day. I have had many woodcock brought to me that had been killed in this way. Mr. George M. Poland of Wakefield says that many woodcock and rails are killed thus. Grouse are also killed by these wires, and by wire fences against which they fly; while the number of the smaller birds that are killed by trolley wires would probably be astonishing if it could be known.

Lighthouses and electric light towers destroy thousands of birds, which fly against them during nocturnal migrations.

Man also contributes to destroy and drive away birds by introducing creatures which molest or kill them. Such are the introduction of the mongoose into Jamaica and other islands, and the importation into this country of the domestic cat and dog, the English sparrow, the house rats and mice, and possibly that of the starling and pheasant. These will be considered under the head of natural enemies.

Cutting off Timber and Undergrowth. — The greatly increased demand for pine lumber brings in the portable sawmill, one of the chief contributing causes to the diminution of hawks, owls, grouse, and all birds which breed, or seek cover, in a heavy pine growth. Mr. Prentiss says: "A man who is a good shot can now, with a dog, follow and kill nearly every bird he flushes; while formerly at least 60 per cent of the birds flushed in a day's hunting would take to the heavy growth of pine, and escape at least for that day." Everywhere I go in eastern Massachusetts the white pine is being cut off. Thousands of acres were cut in the State last year. The demand is everywhere increasing. The great storm of November, 1898, uprooted acres of large pine timber in Plymouth County. Then came the coal strike of 1902, which caused the cutting of many acres of wood of all kinds. This, in addition to the regular demand for pine timber, has caused the destruction, says Mr. A. C. Dyke, of many of the favorite nesting trees of the larger hawks. Cutting pine timber drives out birds which, like the black-throated green warbler, nest there. Where these pines are succeeded by hard-wood trees, other birds will take the places of those driven out;* but where, as in the suburbs of cities, these trees are cut and the ground cleared of even shrubbery, the sparrows, warblers, towhees and thrushes are driven out, as well as the wood birds. Lawns, golf links, country club grounds and grassy parks are unsuitable for the birds of the tangle, and they will not live in such places. The work of destroying the gypsy moth is now necessitating much tree cutting and cleaning up of shrubbery and tangles. This is bad for the birds, and must result in reducing the numbers of some species in the region infested by the moth.

Mr. C. J. Maynard, in his recent work, "The warblers of New England,"† speaks particularly of the warblers having been driven from parks, pleasure grounds and the vicinity of cities by the destruction of the shrubbery. While this may not diminish the number of birds in the State, it tends to drive the birds away from many places where they might be retained under a different policy.

The draining of meadows and marshes drives out the birds that frequent these places. Thousands of acres have been drained and made into cranberry bogs; many swamps have been flowed for reservoirs; swamps near cities are drained and filled. The extension of cities, the building of summer cottages along the coasts, and the increase of population generally, all tend to drive out the birds from their chosen haunts. The effect of these repellent agencies is to reduce the area of the region furnishing a food supply to the birds, and so, in the end, to decrease in the aggregate the number of birds.

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* Prof. J. W. Votey of Burlington, Vt., believes that the growth which follows the cutting off of the spruce furnishes better nesting areas for the birds than those they formerly had.

† Completed Jan. 1, 1905.

The Natural Enemies of Birds.

In the opinion of many correspondents, the natural enemies of birds do no appreciable injury, while others consider them the chief cause of the decrease of birds. It is noticeable that some sportsmen and gunners complain particularly of hawks, foxes, crows, skunks and weasels. At first sight it might seem that those most responsible for the decrease of birds were trying to shift the blame; but we must remember that those who are most in the woods with the birds are most likely to observe their destruction by their natural enemies.

Under normal conditions, the natural enemies of birds are also their friends. There is no better proof of this than the statements made by the early settlers at a time when game birds were here in great abundance. Eagles and hawks were then far more numerous than they are now. Evidently they produced no appreciable effect on the numbers of game birds.

Hawks which feed on birds will overtake the crippled, sickly, least active or most conspicuous birds. This results in a survival of the wariest, strongest, most active and least conspicuous individuals, — in a word, the fittest. It prevents the spread of disease and the propagation of weakness and unfitness; it preserves the race. This is true to a much less extent of the effect of shooting, for a charge of shot will overtake the strongest as well as the weakest, — the fit as well as the unfit. Hawks, owls, foxes and other so-called enemies of birds also protect birds in another way. The horned owl, no doubt, now and then kills a grouse; but it also kills the skunk and crow, which destroy the grouse eggs or young. Hawks may kill game birds as well as other birds; but they also kill squirrels, crows, jays and weasels, the enemies of these birds. All this may be true of the hunter also; but hawks, owls, foxes and weasels kill, in addition, field-mice, deer-mice and shrews, all of which might otherwise increase unduly, and become very destructive to eggs and young birds. No one knows how often the nests of birds are broken up by deer-mice. They climb trees like squirrels, nest in hollow trees, and may be as great a danger to birds as is the dormouse of Europe. Shrews are notorious flesh-eaters, and possibly may be very destructive to ground-nesting birds; while field-mice, when pushed for food, are among the most destructive rodents known. These creatures probably feed mainly at night; their habits are not well known. They can be held in check by natural means only, hence we must *beware of destroying the animals that feed on them.* Acknowledging, as we must, that under natural conditions the natural enemies of birds are useful, there is no doubt that under the artificial conditions produced by man some of them may at times need artificial check. Under natural conditions, the crow is certainly a valuable force in nature; but when we have destroyed the raccoons, the larger hawks, owls and eagles, — the only creatures besides man, perhaps, which serve to hold the crow in check, — then we must also check the increase of the crow, or, wanting sufficient food, it will become very destructive to grain, fruit, fowls and smaller birds. In like manner we have destroyed the wolves, which formerly kept the fox in check; we must, then, check the fox, lest it, increasing, attack our fowls and the game and insectivorous birds. For this reason, it is well that the fox and crow are not protected by law.

Partly because of the fact that the natural enemies of birds may sometimes need an artificial check, and partly because the injury done by them is often much magnified, it seems best to publish some evidence of their comparative harmfulness, under the conditions now prevailing in this Commonwealth.

The natural enemies of birds, noted as harmful by the observers who have contributed to this portion of the report, may be arranged in the following order, with reference to the number reporting each: cats, eighty-two reports; foxes, fifty-eight; crows, fifty-four; English sparrows, thirty-nine; hawks, thirty-four; jays, twenty-six; owls, twenty-two; the elements, twenty-one; * weasels, seventeen; skunks, six; snakes, three; pheasants, three; minks, three; orioles, three; chipmunks, two; raccoons, one.

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* This subject was quite fully treated in my last special report, and will not be further noticed here.

Cats and Dogs. — The destructiveness of the cat is noted not only by the greatest number of observers, but, with remarkable unanimity, nearly all who report on the natural enemies of birds place the cat first among destructive animals. The domestic cat, then, introduced, fed, pampered and petted by man, leads the list, and sometimes leads even the sportsman in number of birds killed per day. Mr. Brewster tells of a day's hunt by four sportsmen with their dogs, in which they killed but one game bird, a bob-white. On their return at night to the farmhouse where they were staying, they found that the old cat had beaten their score, having brought in, during the day, two bob-whites and one grouse. Reports of the cat's destructiveness come from every county in the State. Cats in good hunting grounds will average at least fifty birds each per year. I have recorded heretofore the destruction of all the young birds in six nests and two of the parent birds by one cat in a day. Cats kill for the sake of killing, and destroy more birds than they can eat. They take a savage pleasure in playing with their prey, and torturing it in the most cruel manner. Cats are also more destructive than other animals, because so much more abundant. A friend who was raising pheasants was obliged to kill over two hundred cats in a few years. Game birds suffer much from the cat, but the smaller birds suffer more. Cats are far more destructive to birds than the fox, for they climb trees and take the young out of the nests. They easily catch young birds which are just learning to fly. They frequently catch the adult birds upon the ground when they are feeding, or when they are drinking or bathing. The most harmful characteristic of the cat is its tendency to revert to a wild state. If a dog loses its master and cannot find its home, it seeks to form the acquaintance of a new master; but the cat is quite as likely to take to the woods and run wild. It then becomes a terror to all living things which it can master. Whoever turns out or abandons a cat or a kitten in the country has much to answer for. Proofs of the destructiveness of cats are not wanting. They were introduced on Sable Island, off the coast of Nova Scotia, about 1880. They ran wild, and, multiplying rapidly, exterminated the rabbits which had been in possession of the island for half a century.* On Aldabra Island, about two hundred miles north-west of Madagascar, cats are common. They have decimated the birds, having exterminated a flightless rail, an interesting bird peculiar to this group of islands. Cats are also numerous on Glorioso Island, and, as a consequence, the birds on this island are even less common than on Aldabra.†

Dogs destroy comparatively few birds, but some dogs will eat every egg they can find. Some dogs catch and kill young and even adult game birds. Dogs, like cats, kill other animals for sport. They are not nearly so expert at catching birds as cats, but they chase and molest birds even where they cannot catch them.

The Red Fox. — Fifty-eight people regard the fox as one of the most injurious enemies of birds, thus placing it next to the cat in destructiveness. This is entirely at variance with my experience. I have followed the tracks of foxes for many weary miles through the snow about Wareham, where they seem to live, in winter at least, on mice, marine animals, an occasional muskrat, and such bones and dead marine and other animals as they can pick up; but I have never seen any conclusive evidence there that a fox had killed a bird. My son dug out a fox's burrow, but there was no sign that any live bird had been taken there. Foxes pick up all sorts of meat scraps, chicken legs, heads, etc., and kill some birds, as well as poultry; but, according to my experience, this is the exception and not the rule. Mr. William Brewster, who has been in the woods more than most gunners or sportsmen, tells me that he has seen very little positive evidence of the destruction of birds by foxes, although occasionally they kill game birds. Mr. William S. Perry of Worcester says that foxes kill practically no birds. He has shot a great many foxes and examined their stomach contents, as well as those of foxes killed by others, and says he has never found the remains of a bird in a fox's stomach. At a recent meeting of the Massachusetts Fish and Game Protective Association, Mr. A. B.

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* "The danger of introducing noxious animals and birds," Dr. T. S. Palmer, Year Book of the United States Department of Agriculture for 1898, pp. 89, 90.

† Proc. U. S. National Museum, XVI., 1894, pp. 762, 764.

F. Kinney stated that he had examined the stomachs of eighty-five foxes, and found only two quail, one woodcock and one partridge. Mice, frogs, rabbits, berries and frozen apples were among the food material found. Mr. H. W. Tinkham of Touisset says that in his hunts this year he has observed only one case where a bird had been killed by a fox; the bird was a crow. Of thirteen fox stomachs he examined, only two showed any remains of birds; and out of ninety fox excrements, only one showed birds' remains. The food evidently consisted mainly of mice and other small mammals.*

This, however, is only negative evidence. There is convincing, positive evidence of the destructiveness of the fox to offer. Mr. C. L. Perkins of Newburyport writes: "Have made it a practice, when skinning foxes, to open the stomach, and have found, in seasons of bare ground, moles, field-mice, etc.; but when the earth is covered with snow, the stomach will generally contain remains of grouse or rabbits. This is no doubt due to the habit of the grouse to bury in the snow." Mr. F. B. McKechnie of Ponkapog tells the following: "In May and June of the present year I was at a loss to account for the destruction of numbers of birds' nests found by a friend and myself about Ponkapog. Catbirds, song sparrows, thrashers, black-billed cuckoos, ovenbirds, redstarts and other nests were robbed of their contents with astonishing rapidity. Red squirrels and snakes were very scarce in the pasture where these nests were found, and after some discussion we laid the destruction to foxes. It is well known that foxes will follow a man's track; but it was not for some time that we found out that they were deliberately following us, and taking the eggs and young of all the nests, either on or near the ground, which we had stopped to examine. In the first part of June we got the first clew, when a young fox, following Mr. Horton, walked to within a few yards of him in a swamp where he had stopped to watch a Canada warbler. In the morning of June 19 Mr. Horton again saw two foxes, nearly full-grown, skulking along behind him. He directed me to a song sparrow's nest with six eggs which he had found and photographed during the morning, but before I got there the eggs were taken. In fact, as many as twelve nests were robbed before we discovered the cause."

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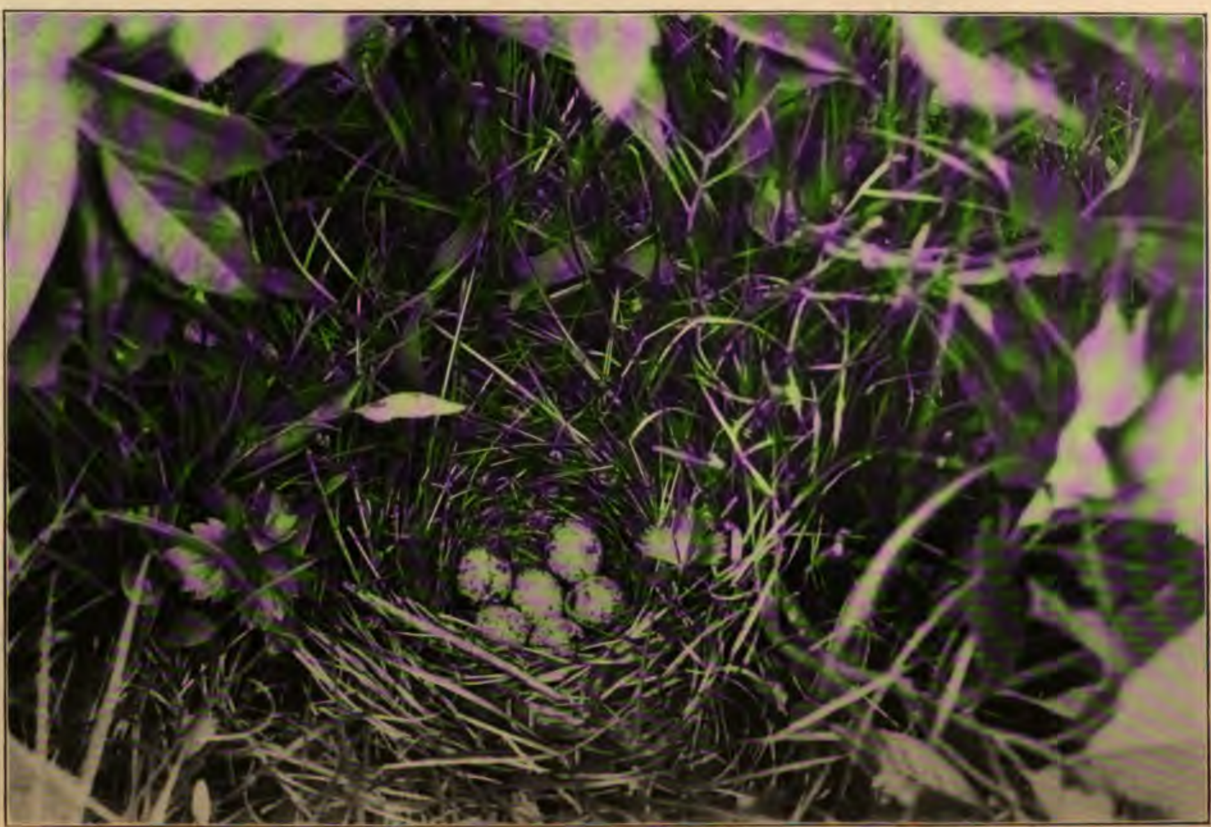
* The inadequacy of an examination of stomach contents alone to determine the character of an animal's food is seen, when we consider that we get, in this way, evidence of only one meal out of all that the animal has eaten during its lifetime.

Mr. I. Chester Horton corroborates this. He writes: "I have spent some time the last two years in photographing birds' nests on, or near, the ground, and was sorry to find in 1904 that nearly all the nests I visited were robbed and destroyed. One song sparrow's nest was robbed a few hours after I visited it, apparently by some animal that had followed my track. One morning, while watching a bird, I concealed myself in the branches of a small pine tree. While watching there I heard a fox bark, and soon found he was coming in my direction. In a few minutes two foxes appeared, following my track, and came within fifty feet of where I stood, stopped as though they partly detected my presence, and, after playing a few minutes, made off into the woods. On another occasion a half-grown fox, following my track, came within fifteen feet of where I stood, perfectly motionless, in a swamp. I have no doubt that foxes discovered that I was seeking birds' nests, and followed me and robbed the nests I found. While photographing nests I found three ovenbirds' nests, within a radius of a few hundred feet, one being partly built, the other two with freshly laid eggs. I waited several days and visited them again. I should have stated that one of these nests was about five feet from a path, and, knowing that something was following me and destroying nests, I did not move out of the path in visiting this nest. The nest that I found partly built I photographed after it had eggs, as it was rather peculiar, being constructed entirely of, and lined with, pine needles. I also intended to photograph the third nest, with the bird on it, as she was very tame; but on my third visit it had been robbed, as was the one I photographed. I visited the one by the path several times, but *never stepped out of the path*, and did not photograph it, and was gratified to see the eggs hatch out and the young



NEST OF SONG SPARROW.

Photographed by I. Chester Horton, and afterwards robbed of the Eggs by a Fox.

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grow to be large enough to leave the nest. One nest I found, that of a brown thrush, two feet high in a blueberry bush, was robbed when it had young half grown."

If foxes follow the tracks of people who find birds' nests, then bird study and photography may prove dangerous to the birds.

Mr. C. E. Ingalls once intimated to me that he had some reason to believe that a fox had followed his tracks to a bird's nest. In response to a written inquiry he sends the following: "I had at one time under observation the nest of a meadowlark. One afternoon about sundown I passed the nest with its full complement of young a day or two old, with everything looking favorable for a successful development. I passed from the meadow where the nest was situated up to a hillside adjoining, and in full view of the location of the nest. I seated myself upon the ground to watch some spotted sandpipers that I felt sure were nesting beside the brook flowing through the meadow, when I saw a fox come to the lower end of the meadow and begin to hunt, as I supposed, for mice. In the course of his quartering over the ground he apparently stumbled onto my lark's nest, and, as he became aware of its proximity, he pounced sharply to one side right into it. I jumped to my feet and shouted to him, and ran towards the nest, while Mr. Fox loped airily and quickly to the woods. When I arrived on the scene, two of the young were gone and one other lay about a foot from the nest, dead. One pleasant evening in May I was sitting on a log near the edge of a piece of mowing land, where it joined some scrub on the edge of a wood. . . . While waiting, I saw a fox on the edge of the grass land mincing along, in no hurry, and evidently hunting for mice or grasshoppers, as he would thrust his muzzle into the grass, then dance around as if watching some moving object in the grass, make a grab, then move along, all the time coming nearer to my position, which was hidden from him so long as I remained motionless. Suddenly, when the fox was within five or six rods of me, a big ball of feathers flew out of the scrub at him and drove him some distance into the grass land. I immediately sized the situation up. A partridge (ruffed grouse) was warning Mr. Fox that she had claims to that particular tract of land that he would be required to respect. But Mr. Fox was evidently hungry, so he followed the brave little mother back to her nest beside a stump on the edge of the scrub. Although the bird made one or more rushes, they were of no avail, and, although I did not at first intend to harm the fox, as at that time of year he would be of no use to me dead, I regarded it, in the light of recent developments, to be a case for armed intervention, so I put a bullet where it would do the most good, and he died within his length of the nest, with his mouth and throat filled with egg contents."

Probably foxes kill some of the young of the smaller birds when they are learning to fly, catching them as cats do. Of this habit Mr. F. H. Mosher says: "I have seen but one instance of the fox catching a bird, and that was several years ago. I was standing on a rise of ground that overlooked a wet meadow. A fox came out of the woods and appeared to be hunting for mice in the grass. As he came opposite a small clump of bushes, a small bird flew out and started for the woods. The fox ran a few steps after it and gave a tremendous spring, and caught it on the wing. Probably it was a young bird."

If foxes quarter over the ground in summer, as they certainly do in winter, it would seem impossible for any nest on the ground to escape their notice, unless, indeed, they are unable to smell the sitting bird. Prof. C. F. Hodge told me in 1903 that he had found by experiment that trained pointer and setter dogs were unable to find a ruffed grouse sitting on her nest, even when, in one case, the bird had left her nest and walked about a short time previously. This seems to indicate that these birds leave no scent during incubation; but Mr. Brewster informs me that his dog on more than one occasion found a woodcock on her nest. It seems probable, however, that ordinarily dogs and foxes find only such nests as they happen to stumble upon; otherwise, what is to prevent them from destroying the broods of nearly all ground-breeding birds?

In order to determine the value of the evidence against the natural enemies of birds, letters were written to nearly all who regarded crows, jays, foxes, squirrels and weasels as particularly injurious, inquiring what evidence had led to this conclusion. Some of the replies showed that the evidence was merely hearsay, others appeared to be the result of personal observation.

Regarding foxes, Mr. J. H. Wood of Pittsfield writes as follows: "I visited a swamp in the vicinity of Ashley Lake, for the purpose of running the white rabbits with a hound. There had been a heavy snowfall a day or two before, and in following a bank on the edge of the swamp we noticed several holes in the snow at the foot of the bank under some spruce trees. We also noticed a fox track and some feathers about a hole. This led me to investigate, and I found that this one fox had killed four out of the seven partridge that had taken refuge in the snow from the storm of the previous day. We tracked this fox from where he had eaten the first bird to a ledge, where we succeeded in finding one of the birds that had been carried there by the fox. My next experience was in 1902, about the 20th of November, when I found a place where some men were getting out stone. They had uncovered a fox's burrow where there had been a litter of foxes the past summer, and if you could have seen the parts and feathers of the partridge you would have been surprised."

Mr. W. J. Cross of Becket, also in Berkshire County, a fox hunter himself, says: "Every hunter of the fox has found, when following a track, the circle of feathers telling the story of where the ruffed grouse made his last dive under the snow to furnish a meal for Mr. Fox the next morning."

Mr. W. H. Snow of Becket says: "I have seen where the foxes have killed and eaten the partridges when there is a snowstorm. The partridges get under spruce trees to get shelter for the night, and they are caught by the foxes."

Mr. Thomas Allen of Bernardston, Franklin County, asserts that he has found the remains of grouse partly eaten, or feathers alone remaining, where fox tracks showed plainly. Others have related to him similar experiences. One saw a fox eating a grouse.

Mr. George E. Whitehead of Millbury, Worcester County, says: "Every observing hunter or trapper can tell you the story of the fox's attempt to ambush a partridge, as told by the tracks on the snow. One can plainly see how the fox took advantage of every bit of natural cover, while he sneaked to where he made his spring. The fact that a few feathers are left shows that he met with success."

Mr. Otis Thayer of West Quincy, Norfolk County, says that after the Blue Hills Reservation was closed to hunters, game increased very rapidly, for foxes were scarce; but as the foxes increased, game decreased. Formerly, he says, this region was good hunting ground; now he finds no game, but always finds foxes. They are now so plentiful that they are becoming destructive to poultry as the game decreases.

Mr. W. H. Aspinwall, secretary of the Massachusetts Rod and Gun Club, writes as follows: "During the last few years I have twice, if I remember aright, found the place where a fox had very recently killed a partridge and eaten him. It was so recent an act that my setter pointed at the place, and I went up and found the remains of the partridge, and foxes' tracks all around. The only fox that I ever shot I ran on quite unexpectedly while working up a bevy of quail. It was a young dog fox, and he was on the same errand that I was, for the quail flushed when I killed the fox. I have made a great many inquiries among the native hunters in our country districts, and they all believe that foxes and skunks, especially in the breeding season, are very destructive to our game birds. I have been told by a number that in digging out foxes that have holed they have found the remains of partridges, and even of the smaller birds, such as robins, etc. Only last week a friend of mine who is an extremely good observer and sportsman told me that he found the remains of a robin which a fox had just killed. I believe that the chief difficulty is in the breeding season, when it is quite easy for foxes to catch the hen bird on a nest. I think that most people agree that, as the foxes have increased tremendously in numbers in the neighborhood of our reservations, such as the Blue Hills Reservation, the partridges have decreased in about the same proportion. That foxes have increased in eastern Massachusetts is proved by the evidence that within the last few years a great deal of poultry has been destroyed, even in such a closely populated district as Chestnut Hill; and foxes have been seen quite frequently. I believe that the State should in some way make a decided stand in destroying the vermin in the reservations, if they desire to make this a favorite breeding ground for the birds." Considerable further evidence of this same character was received. There is at least one reservation where foxes are not protected. Mr. Charles P. Price, superintendent of the Middlesex Fells Reservation, tells me that the foxes have been all killed or driven out of the reservation, and that game birds have increased there. About fifteen foxes per year were killed for three years.

Mr. Henry B. Bigelow of Cohasset says: "Foxes are particularly destructive to quail and partridges in this neighborhood; the entrance to every fox hole is strewn with their feathers; and to my certain knowledge one fox, in 1899, killed, during the autumn, six out of a covey of twelve to fourteen quail. Partridges also suffer, as shown by the presence of their feathers about the dens, as do also domestic fowls."

Mr. S. J. Harris of East Dedham writes: "I once shot at a fox having a partridge in his mouth. I did not know that it was a partridge when I fired at the fox, but he dropped it when I fired, and of course I got the partridge."

The limits of this report will not permit the printing of half the evidence received against the fox. Some evidence from other parts of the State is given in brief below. "A common occurrence to find where foxes have caught and eaten partridges, both on snow and bare ground." (Herbert A. Bent, Franklin, Norfolk County.) "Have never yet seen a section of country where foxes and partridges were plentiful at the same time." (H. R. Packard, Attleborough, Bristol County.) "Have seen feathers of birds around his burrow. Where the fox lives, the game disappears." (A. C. Southworth, Lakeville, Plymouth County.)

This evidence, like the rest, is largely circumstantial; but it seems sufficient to prejudice the case of the fox, somewhat, and leads to the belief that in some localities we may have too many foxes. The fox is well able to take care of itself. Its natural enemies have been nearly all extirpated, and it must be kept within bounds, or it may become a pest. Under ordinary conditions, however, there are fox hunters enough to hold the fox in check.

The Common Crow. — The crow is now regarded by so many people as a useful and much-maligned bird, that it may not be out of place to present here some of the evidence against it. I have already given to this Board some of my experience with the crow, concerning its destructiveness to birds,* and will only say here that I have repeatedly observed crows in the act of destroying the eggs and young of other birds; they are so addicted to nest-robbing that it is a wonder that any young of the smaller birds can be reared where crows are numerous, and my experience indicates that in some cases very few are actually reared in such localities. Since, in view of my own experience, I may be considered as prejudiced against the bird, I will quote mainly from new evidence secured in this inquiry. It will be impossible to present here more than a small part of the evidence received, giving it in the words of the witnesses, to avoid any possible distortion.

In a letter written by Mr. Ingalls, in 1896, he says: "I have seen the nests of many birds of several species, from the ruffed grouse to the red-eye and chippy, robbed before my own eyes, and have evidence of many more. Every season, late in May or early in June, the crows make a raid on the birds nesting in the shade trees along our village streets and in orchards and private grounds, systematically searching every tree, destroying nests, and eating or carrying away the eggs and young." Now, after eight years more experience, he rates the crow as the most destructive of all the natural enemies of birds.

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* Report Massachusetts State Board of Agriculture, 1896, "The crow in Massachusetts," p. 285; see also *ibid.*, 1902, p. 147.

Here is another experience from another county: "For the past ten years, during the breeding season of the birds, from the last of May through June and July of each year, I have watched the crows eat the eggs and little birds. I have watched them start at 4 o'clock in the morning, or a little later, and hunt over the shade trees that line the streets for the eggs and young birds, even going into the trees that stand close to the buildings, where people would not think a crow would ever go. This is done, of course, before people rise; and as soon as any one stirs out they will leave, but will begin the next morning just the same. Any one can plainly see what they are up to. After the breeding season they will not visit the shade trees until the breeding season begins the next year, and then they are ready to follow them up again." (Anson O. Howard, East Northfield, Franklin County.)

"I have many times seen crows eating robins' eggs, and have also seen them flying from nests with the young birds in their beaks. This was probably food for their own young. I often see them very early in the morning, searching trees near houses where small birds have nests." (Samuel S. Symmes, Winchester, Middlesex County.)

"I have seen crows come to the eaves of a house and take young robins from the nest." (S. F. Stockwell, Auburn, Worcester County.)

"Crows are remarkably plentiful here. Have not known a nest of young birds to mature this year. Saw a crow take young out of nests right by the house." (W. J. Hunter, Lincoln, Middlesex County.)

"I have seen crows drive birds from the nest, and take and eat whatever was in it, whether young birds or eggs. There is one tall elm tree in particular on the boundaries of our place where I have watched them repeatedly attack the birds and eat the young." (Amelia M. Brastow, Wrentham, Norfolk County.)

"The crows visit the orchard very early in the morning, usually about sunrise, and after their visit you can find many nests without eggs, that had a full complement the day before." (I. Chester Horton, Ponkapog, Canton, Norfolk County.)

"Directly back of my house is a bush pasture, in which are a few pines, cedars and birches. In the pines and cedars numerous robins build every spring; and every spring about the nesting time of the crows I see them searching through these pines and cedars for — something. At no other time of year do I ever see a crow even alight in this pasture, to say nothing about visiting each tree separately, with every action indicating a search for something. One morning a few years ago I saw a crow drop into the top of a certain cedar in this pasture, and pick the eggs, one by one, from a robin's nest there and eat them. A year or so later I saw the same thing done again, although this nest was in another cedar. At another time I saw a crow visit a robin's nest in an oak tree. This nest contained young birds perhaps a week old, and despite the protests of the parent birds, they were all carried away, apparently to feed the crow's young. In a clump of pines south-west of the house a pair of crows had a nest one year, while the crows' hunting ground was to the east of the house, so that the old crows often flew over the house while passing from the hunting ground to the nest. On one of these trips a crow had in its bill a young bird, unfeathered, which I identified at the time as a young robin. While there are many nests built every year in the pasture referred to, I estimate that not one in ten ever contains young, and not half the young ever leave the nest alive. I know that at least one crow visited this pasture every day." (R. H. Carr, Brockton, Plymouth County.)

"Crows destroy many nests of eggs. Think them the worst enemy." (R. H. Cushman, Bernardston, Franklin County.)

"I have seen crows attack the nests of our common birds many times, and carry off the young birds to be used for feeding their own young during the nesting season. . . . Both crows and red squirrels are fond of birds' eggs, and I have found the empty shells of eggs of birds near their nests many times." (Henry N. Smith, South Sudbury, Middlesex County.)

"I have many times seen crows in the act of robbing birds' nests." (Fred H. Kennard, Brookline, Norfolk County.)

"I, and an absolutely trustworthy friend, have on several occasions seen crows carrying young birds away, though we have been unable to identify the victims. Last June a robin's nest near my house was despoiled by crows, and three young birds were taken; the fourth fell to the ground." (Emily B. Adams, Springfield, Hampden County.)

"This bird does more damage to the farmer than almost all other birds. He deliberately kills our young song birds, our insect-eating birds. He has been seen to go through our grove of maple trees, each side of the highway, destroying the nests and young birds. Our village is well provided with shade trees, and nearly every tree is occupied by one or more birds' nests, mostly robins, with many smaller birds; and in the woods outside we always have plenty of crows. In the nesting season, early in the morning, from half-past 3 to 5, you will find plenty of crows hunting the trees for nests, and it is always a *still hunt*. I make it a point to look after them at this season, and have shot quite a number of them with both eggs and young birds in their possession. One morning I shot one from my door with a young robin, two-thirds grown, in his bill. There are two or three others here that I have interested in protecting the birds, so that we manage to have some of them, and make it rather hot for the crows." (W. J. Cross, Becket, Berkshire County.)

"The crows gather in quantities about the maple trees lining the highway, and fight our robins, often destroying the old bird, and then destroying the eggs or young; also the chipping sparrow. Then, again, they attack our red-winged blackbirds' nests. The crow is well aware who has the gun, and makes his visits early, about 3.30 A.M., as soon as signs of life appear. He is out when no gun is at hand. This is our greatest enemy to song birds, and a bounty ought to be placed on him." (Edgar C. Clark, Wilbraham, Hampden County.)

The above statements, coming, as they do, from many sections of the State, go far to substantiate the claim made by some persons that the crow is everywhere the greatest natural enemy of the smaller birds. Professor Hodge told me that crows had repeatedly robbed robins' nests *in a city lot*, under his windows, coming very early in the morning, before people generally were out of bed. They are just as inveterate thieves of the eggs and young of the larger birds. Several observers speak of crows taking the eggs and young of fowls and turkeys. This is a habit so well known that it hardly need be alluded to here, except to show their taste for eggs and nestlings.

Mr. Price, at the Middlesex Fells Reservation, is raising both wild and domesticated ducks and pheasants. He says that crows took five out of seven young ducks in one day. In June about one hundred Mallard ducks were turned out on a small pond. Ducks lay their eggs very early in the morning, and every morning crows were seen carrying off eggs. Mr. Price says they took about fifty each week, carrying off, altogether, from eight hundred to one thousand eggs during the season, taking about all the eggs laid by the ducks.

It is probable that where one instance of crows robbing nests is observed, a thousand pass unnoticed. There is only one redeeming feature in the case of the crow, and that is, that not all crows habitually rob birds' nests; for if they did, they would destroy most other birds, and in time we should have few birds but crows.

Squirrels. — Forty-two observers regard squirrels as very injurious to birds, thus ranking them next to the crow in destructiveness, and some regard them as more vicious than the crow. Others believe that squirrels do no harm, as they have never seen them troubling birds in any way, nor seen birds manifesting any alarm at their presence. Mr. Brewster is very positive that the squirrels have never troubled the birds at his place in Cambridge, where he has watched carefully for years the habits of both birds and squirrels. Mason A. Walton, the hermit of Gloucester, says that he has several times seen red squirrels examining the nests of birds, but that they never disturbed the nests or young birds.*

There may be many good squirrels, but there certainly are some bad ones, as the literature of field natural history teems with instances of their destructiveness. To convince the reader, some new evidence is appended, collected during this inquiry.

"Red squirrels, I think, do fully as much damage as crows. For a number of years I had quite a colony of red squirrels on my premises, and protected them, as the family liked to see them around. But one morning there was a great commotion among the robins in the yard; I stepped to the door with gun in hand, expecting to find crows, but, on looking closely, found a red squirrel at the nest, from which he soon started, carrying something in his mouth. I fired at him, and he dropped to the ground, and with him a young robin with the head partly eaten; and on looking the ground over, I found two others in the same condition. Since then by observing closely I have found them despoiling the nests of robins and other birds of either the eggs or young, and shoot them on sight, as a nuisance." (W. J. Cross.)

"I was at work in one of my gardens when my attention was attracted by the cries of a pair of thrushes near by. On approaching, I discovered a red squirrel sitting upon the nest, busily devouring their young. I drove the little rascal away with stones, but he returned again, and had bitten the remaining birds before I reached the nest again, it being several rods distant. The next day I found nothing left but the empty nest. The young thrushes were more than half grown, and were all destroyed, undoubtedly by this same squirrel." (Henry N. Smith.)

"There is an apple orchard on the rear of my place, and during the summer of 1903 I was surprised to see the robins, etc., continually building new nests. They would no sooner have a nest finished and eggs laid, than they would be at work on a new one, usually in the same tree, the first one having been abandoned and the eggs missing. One day in passing through the orchard I saw some robins fluttering and scolding about one of the nests, and, being interested, tried to see the cause of the trouble. I found there was a red squirrel sitting on the edge of the nest, devouring the eggs as calmly as possible. I had noticed previously that a pair of red squirrels made their home in a hole in one of the trees, and saw that they were undoubtedly the cause of the depleted nests. I killed the squirrels, and there was no more trouble." (I. C. Horton.)

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* "A hermit's wild friends," Mason A. Walton, p. 69.

"Some five years ago I noticed that some species of birds were decreasing in a certain small piece of woodland that I look over pretty carefully, and the many rifled nests convinced me the red squirrels were doing the mischief. I started a campaign after them, and from that time until the present have shot them on sight. During this time have caught them in the act of rifling robins' and catbirds' nests, and with fledglings in their mouths; also found egg shells around squirrels' nests on the ground. On one occasion saw a pair of robins catch a red squirrel at their nest, and with the help of others drive him from it and chase him to cover. An egg had been taken from this nest, which I found on the ground uninjured, where he evidently dropped it in flight. For some time I had another robin's egg, dropped by a red squirrel, that had been neatly punctured ready to suck." (F. C. Dodge.)

"In the spring of 1896 my attention was first drawn to the red squirrels robbing birds' nests. In the early morning I have repeatedly seen the red squirrels going from tree to tree, hunting for birds' nests. If these nests contained young birds, they were taken out and eaten by the squirrels. The birds around our place decreased rapidly, and the squirrels increased. Catbirds, which had begun to nest around here in numbers, as the locality apparently suited them, were entirely driven off, and no longer build nests here. I think it was about four years ago that we killed off numbers of red squirrels, and the birds began then to increase." (Amelia M. Brastow.)

"I have many times seen red squirrels in the act of robbing birds' nests, and this year saw a young gray apparently at the same trick." (F. H. Kennard.)

The foregoing instances seem to establish the fact that certain squirrels at least which have acquired the habit of molesting birds are among their most dangerous enemies. Squirrels are very active, keen of sight, can climb anywhere in a tree, and it is difficult for a bird smaller than a hawk or crow to defend its nest against them. I have seen a squirrel continually attempt to reach the nest of a robin, although, being assailed from all sides by both robins and jays, it was struck and repeatedly driven back toward the ground. In courage and activity the red squirrel is superior to the gray, and is usually regarded as the greater enemy to birds. At Wareham the birds seem to regard both species with equal aversion.

Some squirrels have a habit of cracking the skulls of young birds, as they would a nut. Mr. F. H. Mosher tells me he has observed this habit at Hyde Park, Dutchess County, N. Y., and also at Dartmouth, Mass. At Hyde Park both red and gray squirrels were observed in the act. He saw the squirrels attack the young on the nests on six different occasions. The birds molested were the chipping sparrow, robin and red-eyed vireo. The squirrel cut off the head of each young bird, dropping the body to the ground, and ate out the brains from the skull. One day in the spring of 1903 he heard the cries of robins at his own place in Dartmouth. He saw a gray squirrel climbing to a robin's nest, and before he could reach the spot the squirrel had the head of a young robin in its mouth. The bird was dead when he reached it. Gray squirrels have been the culprits in each case but one that he has observed.

Mr. Brewster told me that he saw a wounded thrush pursued and overtaken by a chipmunk, that killed the bird and was eating its brains when he reached the spot. He took the bird from the squirrel, but the little animal was so eager and fearless that it would not leave, but stood up trying to reach the bird, like a dog begging for a bone.

Mr. H. H. Dewey writes from New Lenox, Berkshire County, as follows: "Last summer I had occasion to observe a nest of small yellowbirds in a willow bush near where I milked my cows. One morning, as I was milking, I heard several of the old birds making a great noise of distress, and on going near the nest I discovered a chipmunk just swallowing one of the young ones which had been hatched about three days. The chipmunk escaped, and on going to the nest I found only one of the four left. I heard the cries of the old ones early the next morning, and on hurrying to the nest I saw the last young bird being swallowed whole by the chipmunk, which again made its escape. I have for a number of years been suspicious of the little animals doing great damage to either the young birds or the eggs, but have never been able to catch one in the act before."

It seems improbable that the chipmunk actually swallowed a young bird whole, but it may have stowed it away in its large cheek-pouches, for convenience in carrying it off. It is probable that only certain individuals among squirrels molest birds. Such individuals must be killed by those who would protect the birds.

The English Sparrow. — Many people consider this the most destructive of all the natural enemies of birds, and it may be so, in and near the cities, with the possible exception of the cat. The story of how this bird was introduced here, invading the cities and villages, destroying the native birds or driving them out into the country, was told long ago.* Much might be added to it from my own experience and that of correspondents, but lack of space forbids. There are some localities in the country to which the sparrow has not penetrated, and it has seemed to me that it was hardly holding its own for the past few years, especially in eastern Massachusetts, where in some sections sparrows are not so numerous as in the past, and the native birds are beginning to reoccupy their old haunts. The information gained in this inquiry, however, does not confirm this belief, for every county, except Suffolk, Dukes, Barnstable and

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* "The English sparrow in North America," Walter B. Barrows, Bulletin I., Division of Economic Ornithology and Mammalogy, United States Department of Agriculture.

Nantucket, sends reports of an increase of these birds. The only reports of an increase in the cities come from Fitchburg, Lowell and Waltham; all the rest come from towns, and many from the smaller and more remote villages. All this seems to indicate that, outside the larger cities, the sparrows are still increasing in numbers and extending their baleful influence.

Evidence recently submitted to, and published by, Mr. C. A. Reed, editor of "American ornithology,"* from correspondents in different parts of the country, indicates that the sparrow is still destructive to other birds. The sparrow is largely responsible for the decrease in swallows, martins and wrens. For more than thirty years it has driven these and other birds from their former breeding places, torn down their nests and killed them and their young. The tree swallows and martins have been driven from the bird-houses. The nests of the cliff swallows have been torn down or occupied by the sparrows. The barn swallows have been driven from the buildings they formerly occupied, and because of this persecution the wrens have actually disappeared from the neighborhood of towns and villages. If the sparrow is still increasing and spreading out into the country, we may look for a continued decrease of swallows and wrens.

Hawks. — Every one will admit that hawks kill birds. Thirty-four observers consider them seriously destructive. It is to be noted, however, that, as in the case of the fox, the chief evidence is given by gunners. Nevertheless, it is probably true that, after man, the great bird destroyer, birds are among the greatest enemies of birds. No other animals can pursue birds through the air. No others can follow them in their vast migrations, discover them so far off, or overtake and strike them so quickly. We must, then, look among rapacious birds themselves for some of the most potent checks to bird increase.

The bald eagle feeds mainly on fish, and has little effect on the numbers of other birds. The red-tailed hawk is not now generally common. The red-shouldered hawk seldom kills birds or poultry, but, living largely on field-mice, is believed to be a friend to the farmer; but the goshawk, duck hawk, Cooper hawk and sharp-shinned hawk are all bird slayers. Of these four, the Cooper and sharp-shinned hawks, being most common, are most destructive. The duck hawk kills, like the cat, for the sake of killing. It pursues its prey on the wing, rapidly overtaking swift-flying ducks. Mr. C. E. Bailey reports seeing a duck hawk overtake and strike three teal in succession, and then fly off, leaving its victims lying on the water. Fortunately, this hawk is rather rare in Massachusetts. The goshawk is here occasionally in winter, but the Cooper hawk breeds here, and is still common, locally if not generally. This bird, which is sometimes known as the partridge hawk or chicken hawk, is a feathered pirate. Swift, keen and daring, it is the terror of both birds and poultry. It is the one bird of all others to neutralize the local efforts of the bird protectionist. It is particularly obnoxious to the farmer, for, having once tasted chicken, it continues its forays until it is shot or the chickens shut up. It will sometimes kill full-grown fowls, but probably cannot carry them away. Its keen eye detects the mother bird sitting on the nest. At one swoop it snatches bird, nest, eggs and all in its powerful talons; or it spies the nestlings, and picks them up as food for its own young. Conspicuous songsters, like the brown thrasher, robin, wood thrush, rose-breasted grosbeak and scarlet tanager, are swept from their perches while in full song by this bold marauder, and borne to its ravening brood. Even the crafty blue jay does not always escape. As one of these hawks sweeps into a clearing and strikes its prey, every bird song becomes hushed. In a moment sparrows, warblers, thrushes, titmice, — all the loquacious, musical throng, — find cover, or crouch motionless in their hiding places in silent terror. Grim death has been among them, and it is long before they dare resume their activities. The sharp-shinned hawk is a miniature of the Cooper hawk, although perhaps a trifle slimmer in build. It is widely known as the chicken hawk, and is strong and swift. It is nearly as dangerous to birds as its larger and stronger congener. It breeds here, feeds its young on birds, and will kill birds as large as a jay. It is often mobbed by jays, but not infrequently strikes one of its tormentors, when all the rest fly off, leaving the hawk to finish its victim.

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* Vol. 4, No. 5, May, 1904.

Probably most of the birds now killed by hawks in Massachusetts are struck down by these two species. Sometimes in the fall these birds may be seen in great numbers migrating south. Mr. W. S. Perry estimates that he saw at least one thousand, mostly sharp-shinned and Cooper hawks, going south Oct. 10, 1892. He watched them flying all day. He estimates that each bird will eat on the average two small birds each day, or seven hundred each year. At that estimate, the one thousand hawks which came within the range of his vision would eat seven hundred thousand birds a year. I regard these two birds and the goshawk as the only hawks that should be shot by gunners, most others being a positive benefit, or so rare as to do little harm.

The pigeon hawk, also a bird hawk, is not common, and the sparrow hawk feeds chiefly on insects. The broad-winged hawk seldom kills birds, and the marsh hawk feeds mainly on small mammals in most localities.

The Blue Jay.—The blue jay, a smaller cousin of the crow, has a similarly unsavory record, and also merits it. It attacks the eggs of birds from the size of the smallest sparrow and warbler to that of the robin. The robins, if at hand, will successfully defend their nests; but the jay will watch, and sometimes eventually appropriates the eggs in the robin's absence. The jay pays little attention to the screaming and protesting vireos, but robs their nests as unconcernedly as though the parent birds were not present. When jays have young in the nest, they sometimes watch the nests of the smaller birds very closely. Hardly is a clutch laid when it disappears, and most of the smaller birds lose at least one set of eggs. I am aware that many people find it hard to believe that such a pretty bird as the blue jay can be such a rascal; therefore, I will not ask belief for my own assertions without producing evidence to support them, for the mere fact that twenty-six observers believe the jay to be a destructive enemy of the smaller birds may not be considered sufficient evidence on which to condemn the bird.

"Last spring I was disturbed several mornings by an outcry among the birds in the trees near the house. A pair of blue jays were on a marauding tour, and eggs were the morning's bill of fare." (Thomas Allen, Bernardston, Franklin County.)

"The crows and jays are destructive to the sparrows, robins and vireos that build in our orchard beside the house, where I have a good chance to see them. I believe the jays are about as bad as the crows. Several robins' nests are broken up in this way every year, and always one, and generally two or three, of each of the others." (J. K. Burgess, Dedham, Norfolk County.)

"I have a neighbor . . . who has shot one or two jays in the very act of robbing eggs from nests." (Daniel Ballard, Millington, Franklin County.)

"I have seen blue jays repeatedly sitting on the edge of a nest, eating the eggs. This season I found a nest of a *Vireo solitarius*. . . . I discovered a blue jay in the act of eating up the eggs. When I went to the nest there was only one left, and the shells of three others. I have had the same experience this year with the nest of *Dendroica virens*. I think jays torment these birds worse than any others. I am convinced that jays, during nesting time, hunt for eggs with great skill and regularity." (John E. Thayer, Lancaster, Worcester County.)

Colonel Thayer also writes of Mr. William Brewster's experience. This Mr. Brewster has told me of personally. The methodical manner in which the jays investigated the nests of other birds day after day, and destroyed the eggs, has convinced him of their destructiveness. He says: "I do not consider that owls, hawks (except the Cooper and sharp-shinned), squirrels, weasels or even foxes do any serious harm. The blue jay does very much harm to the smaller birds by eating their eggs; and the crow is also harmful in the same way, but to a less degree, according to my experience."

Mr. S. J. Harris of East Dedham, Norfolk County, speaks of his experience with jays as follows: "Of course the old robins would fight the jays away for a while, but they would come right back again. I have known of a bluebird's nest with four or five eggs in it being robbed by jays, for I came along in time to hear the scrimmage, and, on seeing the blue jay in the bluebird's nest, with the bluebirds screaming and flying at the jay, I went and found all the eggs broken, and the jay had eaten the insides."

Owls.—Owls certainly kill some birds, but the number they take is ordinarily so small in proportion to the noxious mammals and insects they destroy that they are believed to be among the most useful of birds. It is, however, rather amusing to hear one friend of the screech owl defending it from the charge of killing small birds, and asserting that it lives on mice and insects, while another says that it is most useful because it destroys so many English sparrows. I have known a screech owl to kill a flicker, occupy its nest and make a meal of the owner. Owls kill many mice, shrews, squirrels, rabbits and other small mammals, and a few birds. The larger species probably kill some game birds. The owls are not so destructive to birds as either hawks or crows. Were they exterminated, we should miss them sadly. The quavering wail of the screech owl at evening is one of the characteristic sounds of our orchards and woodlands; it is becoming altogether too rare in some localities. The booming hoot of the horned owl, now seldom heard, gives warning of the approach of the most dangerous owl of our woods. It kills many hares, or so-called rabbits, mice and rats, and is in this respect a friend to the farmer.

Weasels.—Only seventeen people complain of the weasel, and much of the evidence against it is that of killing chickens. I have for years heard the statement made that weasels were very destructive to game birds. I have followed them for miles, and watched them whenever I could. I have written many letters to people who regard them as destructive, but the nearest thing to evidence against them that has come to me yet is contained in the following notes.

Mr. Thomas Allen of Bernardston says: "Weasels are too sly and quick in movement to be caught. The bird with small, clean-cut teeth marks in the neck or under the wing is proof of this enemy."

Mr. H. B. Bigelow of Cohasset writes: "Weasels kill some small birds, principally sparrows, along stone walls and hedge rows, where I have found several carcasses, principally, however, English sparrows. In Milton I saw a weasel stalk an English sparrow along a stone wall. They are said to destroy some quail."

Weasels are remarkably savage and bloodthirsty animals, but seem to feed mostly on mice, shrews and moles, for which they hunt daily. When hunting they quarter over the ground much more closely than does the fox, therefore they are more likely to stumble on the nests of birds. An animal which can kill six fowls in a night, as I have known a weasel to do, would easily kill a sitting grouse or any smaller bird which it could surprise on its nest at night.

The weasel is very brave and active. Weasels occasionally attack even human beings. There is an old story of an English girl who was found dead on a moor, her body partly eaten by a party of weasels. I was once, when a boy, attacked by ten of these creatures. They made the occasion quite interesting for me for some minutes, and by reason of their great activity all but one escaped unharmed.

Mr. John Burroughs has observed that weasels can climb trees.* This makes them much more formidable enemies to birds than they otherwise would be, but, as their vision is not particularly acute, and as they rely largely on scent, they are likely to be often at fault. Fortunately, they are not common, but I have never seen any explanation for their comparative scarcity. They have many young and few enemies, although the larger hawks and owls get some of them. They can escape the fox by climbing or hiding. Weasels are not often shot, and traps are seldom set for them, but they are often caught in traps set for other animals.

It is quite possible that these bloodthirsty, ravenous creatures are cannibals. Other carnivorous animals, such as predaceous beetles, owls and wolves, are cannibalistic. Mr.

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* "Squirrels and other fur bearers," John Burroughs, p. 87.

Burroughs records that when a pair of weasels was kept in captivity, one killed and ate the other, picking the bones clean.* Their cannibalistic tendencies and the work of the trapper may account for their comparative scarcity.

The Mink. — Minks feed along water courses, where they kill a water-fowl now and then. They also make excursions overland, killing mice, as does the weasel. At times they kill many domestic fowls and some birds. Mr. Brewster has recorded, in "Bird-lore," the almost complete destruction of a colony of bank swallows by one or more minks. Mr. H. B. Bigelow says: "Minks kill few if any quail or partridges, but a good many ducks on the marshes. I have found black ducks, evidently killed and partly eaten by them." Their fur is valuable now; they are trapped much, so they are rather rare, which is fortunate for birds and poultry.

The Skunk. — The skunk is a sluggish and rather stupid animal, but knows enough to steal young chickens from under the mother at night. When a boy I once surprised a skunk apparently eating some grouse eggs, while the bird hovered round, afraid to come to close quarters. Wishing to interrupt the proceedings, I undertook to investigate, but was so warmly received by the undaunted animal that it was soon left in undisputed possession of its ill-gotten meal. Probably the injury done by skunks to birds has been exaggerated. While occasionally they may stumble on a nest of eggs or young birds, they are too slow to pursue and overtake any bird that is able to use its wings or legs. I have seen forty fowls roosting two and one-half feet from the ground in safety, while, night after night, skunks came and ate refuse from the ground in the same coop.

Hunters, finding the nest of a game bird despoiled of its contents, are very likely to attribute it to a skunk, without sufficient evidence. Most people who have been much in the woods believe that skunks eat many birds' and turtles' eggs; but thus far I have been able to find but one man who has *seen* the skunk eating birds' eggs. This may be mainly because the skunk usually hunts at night; but Mr.

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* "Squirrels and other fur bearers," John Burroughs, p. 87.

Martin L. Sornborger writes from Haydenville that he has actually seen the skunk eating the eggs in a grouse's nest. He also says he has found the remains of young birds in the stomachs of some skunks that he has examined.

Other Minor Enemies. — Three observers each report snakes, pheasants and orioles as destructive to young birds. The black snake is a deadly enemy to birds, and eats the young in nests both on the ground and in trees. Other species of snakes are probably less destructive.

The introduced pheasant (*Phasianus torquatus*) is reported as killing young chickens and game birds, but the evidence against it is circumstantial, and not very strong.

Orioles are reported as tearing down the nests of other birds and destroying the eggs, — a trick of which a few individuals are undoubtedly guilty.

Raccoons, being nocturnal, omnivorous and fair climbers, are probably destructive wherever they are common; but there is little evidence against them as destroyers of birds, and they are no longer numerous in many parts of this State.

A DISCUSSION OF SOME SUGGESTIONS FOR THE BETTER PROTECTION OF BIRDS.

In reply to the request to suggest means for the better protection of birds, several hundred suggestions were received, which may be classed under forty-six different heads. Those which appear to be of sufficient importance to merit discussion are arranged below, and for convenience classed under four principal heads.

1. *Suggestions regarding Education and Moral Suasion.*

PROPOSED MEASURE.	Number advocating it.
Educate the children in regard to birds, and interest them in their lives.	26
Arouse an interest in the public generally in these matters,	1
Arouse the Massachusetts patrons of husbandry to act on bird protection.	1
Form clubs under the auspices of the League of American Sportsmen.	1

2. *Suggestions regarding the Enactment and Enforcement of Legislation to regulate Shooting.*

PROPOSED MEASURE.	Number advocating it.
(*a*) *General Measures.*	
Enforce the laws now on the statute books, . . .	25
Demand more stringent laws, ...	10
License all shooters, ...	10
Establish a close season on all game birds for three years,	6
Establish a close season on all game birds for five years,	3
Establish a close season on all game birds for ten years, .	3
Shorter open seasons, ...	4
Stop all spring shooting, ...	5
Prohibit the use of bird dogs, ...	5
Have owners of land post notices forbidding trespassing,	4
Prevent sale of all game birds, ...	3
Stop all collecting for scientific purposes, ...	3
Provide heavier penalties, ...	2
Limit the number of birds to be taken in a day, . .	2
Forbid all shooting by aliens, ...	2
Forbid use of all live decoys, ...	2
Regulate bird shooting in the Southern States, . .	2
Forbid all bird shooting by boys, ...	1
Forbid use of automatic guns, ...	1
(*b*) *Measures relating to the Fish and Game Commission.*	
Larger appropriations for the commission, ...	6
Appoint more paid deputies, ...	19
A law giving the right of search without warrant, . .	7

3. *Suggestions regarding Bounty Legislation.*

PROPOSED MEASURE.	Number advocating it.
Offer State bounty on the heads of cats, ...	20
Offer State bounty on the heads of foxes, . . .	16
Offer State bounty on the heads of crows, . . .	11
Offer State bounty on the heads of hawks, or certain hawks.	10
Offer State bounty on the heads of English sparrows, .	10
Offer State bounty on the heads of owls, ...	8
Offer State bounty on the heads of weasels, . . .	8
Offer State bounty on the heads of skunks, . . .	7
Encourage in every way the hunting of birds' natural enemies.	3

4. *Miscellaneous Suggestions.*

License cats, ...	11
Kill off the jays, ...	5
Kill off the red squirrels, ...	4
Put bells on cats, ...	1
Confine cats when birds are learning to fly, . . .	1
Put wire collars on trees, to keep off cats, . . .	1
Plant food plants and shelter plants for birds, . . .	1
Give better protection from forest fires, ...	1
Establish State reservations where birds will be protected,	4
Appoint judges who will fine people for illegal shooting,	1
Prevent spraying trees, ...	1
Stop immigration from Italy, ...	1
Protect birds from English sparrow, ...	1

Educational Work.

We must awaken an enlightened, all-pervading public sentiment in favor of bird protection; then there will be no difficulty in enacting legislation and taking measures which will prevent the extirpation of our native species of birds. Until this is done, all laws for the protection of birds will be more or less inoperative; no law will be generally respected or can be fully enforced. The citizen must understand that the bird is the property of the State, and must take a lively interest in its preservation, guarding its existence as he would that of his own domesticated animals. He should also have an abiding interest in its life, its propagation, its food and its enemies. Such an interest must be awakened first in the school children, for every sane, normal child has the instincts of a naturalist. Children should be taught not to skin birds or collect their eggs, but to build bird-houses, furnish materials for building nests, feed birds, and attract them about the home. They should be taught the usefulness of birds as destroyers of injurious insects and noxious mammals. They should be taught also to plant shrubs and trees that will furnish the birds food and protection. It is noticeable that twenty-six people suggest that children be taught to value birds. The importance of this measure is becoming generally appreciated. The fact that so many observers have reported the slaughter of birds by boys with guns and air rifles, and the collecting of birds' eggs by children, indicates that bird-study is not properly taught among the children in some localities. Many observers report, however, that in their sections there is little birds-egging or shooting of birds by boys; and it seems to be quite generally believed that this is due to an increased interest in the living birds, caused by such influences as the work of the Audubon Society, and that of the Society for the Prevention of Cruelty to Animals, by nature study in the schools, by humane education and by a general public interest in these subjects. No one can deny that a great change in public sentiment regarding birds already has begun.

The reduction in the amount of native birds' feathers worn as millinery ornaments and the falling off in the traffic and business of taxidermists are among the visible results of the change of sentiment, which has been wrought largely through the influence of the Audubon Society.

An increased interest in animated nature was aroused and fostered more than twenty-five years ago in the State by the Boston Society of Natural History and the Worcester Natural History Society. Nature study has grown in popularity in many States ever since. Massachusetts has kept well on the crest of the great wave of interest in animated nature which has swept over the country. This movement will result in lamentable failure, unless it protects from extirpation those plants and animals the study of which is one of its chief reasons for existence. The work of the American Ornithologists' Union has accomplished more for the protection of sea birds and shore birds on their breeding grounds than that of any other organization. It is due to this work that gulls, terns, other sea birds and shore birds breeding along both coasts of the United States have been saved from decimation or extirpation at the hands of gunners, milliners, hunters and eggers. This work has now been transferred to the recently organized National Association of Audubon Societies.

Every member of the State Board of Agriculture, every branch of the League of American Sportsmen, every natural history club or society, every Agassiz chapter, every grange of the Patrons of Husbandry, every sportsmen's organization, should give active support to all measures that will help to maintain or increase the numbers of useful insectivorous birds, game birds, shore birds and wild fowl, and all should hold up the hands of the United States Biological Survey in securing consistent State laws to protect the birds during their migrations both north and south. The publication and distribution of literature regarding the usefulness of birds and the necessity for their protection should be undertaken by all such societies. The public press can help much by printing short articles on these subjects.

Suggestions regarding the Enactment and Enforcement of Legislation against Excessive Hunting and Shooting.

Twenty-five correspondents urge the enforcement of the laws now on the statute books as the sovereign remedy for all ills now apparent. These statutes are certainly wise in the main, but some of them are not sustained by public sentiment, and therefore are not respected. Such is the law forbidding Sunday fishing. Sunday hunting also is quite freely indulged in, in localities where the deputies of the Fish and Game Commission are not at hand to enforce the law. Local authorities do little to enforce the game laws. Legislatures, while giving fish and game commissions full authority to enforce the law, usually hamper its enforcement by granting inadequate appropriations; so that such commissions are obliged to depend much on the services of unpaid officers, who can devote comparatively little time to their ungracious and thankless task. Notwithstanding this handicap, the officers of the Massachusetts Fish and Game Commission secured fifty-five arrests in 1904 for infractions of the Sunday law. The fines paid amounted to six hundred and ten dollars, and only nine cases were discharged or filed.

Notwithstanding the fact that the Massachusetts commissioners have been very efficient, and are now enforcing the law better than ever before, fifty-eight persons report that the laws are either indifferently enforced, or not enforced at all, in their sections; fifty-seven, however, report that they are well enforced; thirty-two say "fairly well;" and nineteen "as well as possible under the circumstances." Some report that the laws are "respected" in many of the country towns. The farming population of Massachusetts is generally a law-abiding class; but the laws would be better respected if better known. If every farmer in the Commonwealth could have mailed to him a printed copy of the bird and game laws, there would be fewer infractions of these statutes by the rural population. Probably not one person in ten knows these laws. All hope of any better enforcement of the bird laws by this commission lies in the direction of making the force of wardens larger and more efficient. The Fish and Game Commissioners are authorized, empowered and directed to enforce the fish and game laws of the State; this they are now doing as well as they can, with the limited means at their command.

Six reports advocate *giving the officers of the commission a right to search suspected persons in the field without procuring a warrant.* Such an enactment may not be constitutional, but is greatly needed. Every citizen who believes in the protection of our game birds and song birds should favor such a law. It would help greatly to stop ferreting, killing game birds out of season, and the shooting and trapping of the smaller birds by boys and foreigners.

A large number of correspondents demand *more stringent laws* than those now on the statute books. A close season of from three to ten years on all game birds, ducks and shore birds, as advocated by twelve correspondents, would undoubtedly help the birds; this is the only certain way to check the extirpation of the shore birds. But this plan might be opposed by nearly all sportsmen and shooters generally, and there is little hope of its adoption until such time as the danger of exterminating the birds shall become patent to every one. Shorter open seasons no doubt would help; but, unless the season is made of uniform length for all game birds, it is rather ineffectual to shorten the season on one species, for when men are in the field with guns in their hands, all game birds will be shot.

Five correspondents advise *the stopping of all spring shooting.* This is the most important measure yet proposed which seems to have any hope of success. If *all spring and summer shooting could be stopped* throughout the United States and Canada, we should be nearer the solution of the problem of bird protection than we shall be likely soon to get in any other way. The laws of Massachusetts already protect the partridge, woodcock, quail, wood duck, black duck, teal, plover, snipe, rail and marsh or beach birds in spring; but plover, snipe, rail and marsh or beach birds may be killed after July 15. This summer shooting must be stopped eventually. The river ducks should all have the same protection in spring that is now given to black duck, wood duck and teal; and it would be wise to forbid all spring and summer shooting of water-fowl. A moderate amount of shooting in the fall, after the birds have bred, does not reduce their average numbers perceptibly from year to year; but spring shooting tends toward extermination.

When we have done what remains to be done in Massachusetts, some influence must be brought to bear on other States; for, if the birds are shot on their way north through the southern and middle States, and also in Nova Scotia and Newfoundland, protection here will have only partial results. The Province of Quebec protects shore birds in spring in most of her territory; but Nova Scotia laws now give shore birds, except snipe, no spring protection. New Brunswick protects them on a large part of her coast. All the New England States excepting Rhode Island now prohibit the shooting of shore birds during one or more of the spring months, but the laws of the different States do not coincide. Massachusetts leads the New England States by protecting practically all shore birds in spring. New York protects them in spring and summer. New Jersey protects shore birds from January 1 to May 1. Maryland and Delaware give them no adequate spring protection. Virginia protects most of the shore birds in spring. In New Hanover County, North Carolina, shore birds may be shot from September 1 to April 1. In South Carolina, Georgia and Florida they are practically unprotected.

If the laws of all these States could be so amended as to prevent any shooting of the shore birds from January 1 to September 1, we might expect to see a resultant increase among those birds which, like the black-bellied plover, migrate mainly up and down the coast. Such a law, however, would not greatly affect such species as the Eskimo curlew, the golden plover and the Bartramian sandpiper or upland plover, which migrate north through the interior, as the abundance of these birds is governed to a considerable extent by the amount of spring killing done in the Mississippi valley States. Some States in this region give these species no protection in the spring. The laws of Wisconsin, Louisiana, Michigan, Minnesota, Missouri and Ohio, however, now protect plover either partially or wholly from spring shooting.

In regard to legislating against spring duck shooting, Massachusetts, in protecting only wood duck, black duck and teal, from March 1 to September 1, is already behind New Hampshire, Vermont, Ohio, Michigan, Wisconsin and Minnesota; for these States prohibit all, or nearly all, duck shooting during most of the winter and spring months. New Brunswick prohibits the shooting of wood duck, black duck, Brant, teal and geese between December 2 and September 1. Nova Scotia, however, protects only "blue-winged duck," teal and wood duck in spring. The Province of Quebec protects all wild duck except sheldrake in much of her territory from March 1 to September 1, while Ontario sets an example, which we may well follow, by protecting all ducks from December 16 to September 1. Newfoundland, Maine, New Hampshire, New York and Georgia protect either some or all ducks, beginning at a date before April 1.* With the exception of the States named, not any Atlantic Coast State or Gulf State protects ducks, except wood duck in Virginia and Louisiana, before the first of April.† If all ducks and shore birds which migrate south could be protected there and along their routes of migration after the first day of January, and also throughout the spring and summer, both in migration and on their breeding grounds, it seems probable that the diminution in their numbers might be checked. If all organizations interested in the protection of birds or game would work together for this end, it might be accomplished.

The *prohibition of the use of bird dogs*, if it were possible, would undoubtedly save many birds, for some men would be unable to find birds were it not for their dogs. But dogs will be used so long as birds are shot for sport or market. They ought, however, to be confined during the breeding season of the birds, that they may have no opportunity to destroy the eggs or young.

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* Farmers' Bulletin No. 207, "Game laws for 1904," by T. S. Palmer, Henry Oldys and R. S. Williams, Jr., of the Biological Survey, United States Department of Agriculture.

† This applies also to certain counties of North Carolina and Alabama.

Posting Land. — Owners of land will accomplish little in the way of bird protection by merely posting notices forbidding trespassing or shooting, for many shooters pay little attention to such notices. They are useful, however, where there is a man to patrol the land posted, and see that shooters keep off, for notices define the limits of the guarded land, and serve as a warning to all trespassers.

The *prevention of the sale of all game birds taken in the State*, which is advocated by three persons, is a wise measure, and one which must be undertaken sooner or later, *unless* other measures are adopted to save the game. The amount of native game marketed here has greatly decreased already. Our marketmen are now obliged to send to Europe, the Antilles and other regions to secure a supply of game for home consumption. Over forty States and Territories already prohibit the sale of either a part of or all the game taken within their limits. All the British North American Provinces prohibit the sale of certain animals or game birds, or both. Massachusetts is behind the leaders in this movement. She must eventually stand with Arkansas, Colorado, Hawaii, Michigan, Minnesota and Texas, which forbid the sale of all, or nearly all, birds protected by the laws. Eventually poultry and pigeons, or artificially propagated game birds, and water-fowl, raised by our farmers and poultrymen, probably will largely take the place in our markets so long filled by wild game birds.

Heavier penalties for infractions of the game laws might be provided, and perhaps would cause them to be more generally respected.

A law limiting the number of birds to be taken in a day is in force in several States, and may be of some service with conscientious sportsmen, but it is difficult of enforcement.

To forbid the use of live decoys would help to protect the water birds. The arguments for such a law will apply with less force to decoys of all kinds; but there are many difficulties in the way of enacting or enforcing such laws.

The use of the automatic gun should be prohibited. No one who regards the protection of game as important should ever use one.

Those who wish to *forbid all shooting by boys and aliens* are right; unquestionably this should be done. There should be an age limit for shooters, and the aliens who, boylike, shoot at nearly every wild thing they see, should be stopped from carrying arms altogether.

Hunting Licenses. — Possibly both these classes might be shut out largely by licensing all shooters. Apparently the license has now come to this country to stay: In a recent bulletin, entitled "Hunting licenses, their history, objects and limitations,"* Dr. T. S. Palmer of the United States Biological Survey gives a history of the hunting license in this and foreign countries. The license not only furnishes money for the enforcement of the law by paid wardens, but it also increases the interest of the citizen in its enforcement. A man who has paid a liberal license fee is not likely to encourage others in hunting without a license. The amount received from licenses may be considerable. Maine collected last year more than twenty-five thousand dollars; Wisconsin, ninety thousand dollars; and Illinois, nearly one hundred thousand dollars. Massachusetts could never hope to reach these figures, but she might succeed in preventing hunting or shooting by many non-citizens and non-residents through a high-license system discriminating against them. Here, however, we are met by the objection that such an act would be unconstitutional; but this is a question to be decided by the courts. The imposition of a license is nothing new. One of the earliest license laws passed in this country was enacted in Virginia in April, 1691. In the early part of our history such laws were few and perhaps unnecessary; but within the last twenty-five years their necessity seems to have become apparent, and within ten years their number has increased rapidly. They are now in force in thirty-five States and Territories in this country, and also in the seven provinces of Canada. Many foreign countries have long had hunting licenses. In England a man must have a gun license, a hunting license, a license to use a hunting dog, and even, in some cases, a game keeper's license also. In America a resident is usually taxed one dollar, while a non-resident is required to contribute from ten to one hundred dollars.

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* Bulletin No. 19, United States Department of Agriculture, Division of Biological Survey.

The main objects of hunting licenses are two: (1) to limit shooting, especially on the part of non-residents; (2) to raise money for game or bird protection. The license tends to preserve the game of the State for the benefit of its own people, to whom it is held to belong. The utility of the license may be gathered from the fact that ten States licensed more than a quarter of a million hunters in 1903. The license has the advantage that by it the owner may be positively identified. It may contain his description and photograph, and he may be obliged to produce it at the request of any citizen. While I would not be understood as advocating any particular license law, it seems to me that the subject is worthy of careful consideration.

The following extract from a letter from Dr. T. S. Palmer of the Biological Survey of the United States Department of Agriculture, who has charge of the matter of game preservation, shows clearly the measures that he advocates to protect the birds: "The decrease in certain species of birds is not difficult to explain, and it is attributable largely to long open seasons and open markets. Comparatively few States afford shore birds any real protection, the seasons often being open during the height of the migration season, and closed when the birds are absent from the State. The exemptions in some of the laws, allowing practically unrestricted sale of birds taken outside the State, place a premium on the destruction of birds in States where the laws are lax. Fortunately, since the passage of the new law last spring, sale in Massachusetts is now prohibited during the close season, though the privilege of storing game and holding it in possession from one season to another still invites wholesale destruction of game birds for market purposes elsewhere. The destruction of non-game birds is not due to lack of protection so much as to failure to deal effectively with certain special conditions which have recently arisen. The remedy for present conditions is clear, but difficult to apply; namely, to prohibit spring shooting, to restrict the sale of game birds, and to prevent market hunting and indiscriminate slaughter of game and small birds. The destruction of birds by foreigners has thus far assumed a serious aspect in only a few States. The most successful means of dealing with it thus far suggested is a ten-dollar hunting license required of all foreign-born unnaturalized residents of the State. Such a law has been adopted in both Louisiana and Pennsylvania, and has thus far proved quite satisfactory."

Bounty Laws. — Sufficient protection will be given to birds against their natural enemies by the shooters themselves, when they learn what protection is needed. All gunners will shoot the Cooper and sharp-shinned hawks at sight, when they know them and know their character. They will also shoot cats, foxes, crows, squirrels and all the enemies of birds indiscriminately, whenever they recognize them as enemies. Hence, so long as we allow the shooting of game, the shooters are likely to keep the enemies of birds within reasonable limits. Crows, foxes and bird-hawks may increase in some cases, owing to their well-known ability to take care of themselves; but the law does not protect any of these creatures, and they may be kept in subjection without the stimulus of bounty laws. Bounty laws may have been wise and even necessary in the early history of this Commonwealth, when there were wolves, bears, panthers and rattlesnakes to be exterminated; now, however, they are in general unwise, unnecessary, uncalled for, and in effect positively injurious.

We must admit that such laws operate to reduce the numbers of the animals proscribed by them, provided the bounty is made sufficiently large. It is perfectly clear that any animal, the destruction of which will put much money into some one's pocket, is doomed to the same kind of persecution as was the game before it was protected by law. The result of this kind of persecution is patent to all; and if a heavy uniform bounty on any one animal could be paid throughout the continent, it would be, in time, either exterminated or rendered so rare that hunting it would be unprofitable. Admitting that such bounty laws, if uniformly adopted, would be effective, let us first see why their results are, in general, pernicious.

The main object of all bird legislation is to protect the birds. This can be done by restricting both the number of shooters and the time during which shooting is allowed. Bounty laws have precisely the opposite effect. They encourage boys, foreigners and unemployed persons to roam with guns in their hands through the woods and fields at all seasons of the year. This is sure to result in the destruction of game birds and insectivorous birds at all seasons, to say nothing of the poultry and other property of the farmers that, perforce, must suffer. Probably every State that has offered bounties in recent years has had this experience.

Bounty laws always put a premium upon dishonesty. Under the so-called scalp act of 1885, in Pennsylvania, upwards of two thousand dollars were realized for a buffalo hide and a mule skin in one county, by a party of hunters. These hides were cut up and "fixed" to resemble the scalps or ears of predatory mammals. Whether the magistrates also were "fixed" is not recorded. A red fox was slain in one of the mountainous districts and its pelt cut into sixty-one parts, for which the hunter received sixty-one dollars. Bounties were paid on the heads of domestic fowls, grouse, cuckoos, and even English sparrows, which were supposed to have been palmed off on the authorities as the heads of hawks and owls. Birds and mammals were killed in other States and shipped into Pennsylvania, and large amounts of money were thus fraudulently obtained.* This but repeats the history of local and State bounty laws everywhere.

A bounty on cats, foxes, crows, hawks, owls, English sparrows, weasels and skunks would be very expensive to the State. Pennsylvania paid out during one year not less than one hundred and fifty thousand dollars for bounties on birds and mammals. Montana paid out within six months in 1887 more than fifty thousand dollars in bounties for ground squirrels and prairie dogs. As at that time these animals had not decreased perceptibly, a special session of the Legislature was called to repeal the law, lest it bankrupt the State.

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* "Birds of Massachusetts," Dr. B. H. Warren, annual report Massachusetts State Board of Agriculture, 1890, p. 45.

While the effect of bounty laws, in general, is bad, the practical operation of laws directed at particular species is certainly vicious. We may regard a bounty on the heads of cats as impracticable, for obvious reasons, not the least among which might be the encouragement of a new industry, — the raising of kittens for the bounty. A bounty on cats, foxes, weasels and skunks would encourage trapping, which is already exterminating some of the smaller fur-bearing animals. The experience of States which have placed bounties on the head of the English sparrow has not been encouraging. These acts are said to have resulted in a slight decrease of the sparrows, and the destruction of great numbers of native birds killed and ignorantly offered for bounty. To put a bounty on the head of the sparrow is practically equivalent to offering a bounty on all our native sparrows, many of the warblers, the thrushes, wrens and a few other species. Anything that at a distance looks like a sparrow would be killed, and probably in most cases the bounty would be paid, unless a competent naturalist could be appointed in each town or county seat to pass on the heads.

If we offer a bounty on the crow, most of our native crows which do the mischief probably will escape, and the bounty will be paid mainly on birds that came from the north in winter. The difficulty of killing crows in the summer prevents many being taken at that time. In the winter most of the crows that summer here probably go farther south, their places being taken by crows from farther north. It is at this time that crows are most readily killed, either by baiting or at their roosts; and therefore most of the crows offered for bounty would be those which never do any injury here, while the guilty ones would escape.

A bounty on hawks or owls would work injury to the agricultural interests. Hawks, with a few exceptions, are useful birds. Owls, being probably among the most useful of all birds, should be protected by law, rather than proscribed. When in 1886 the people of Pennsylvania became aware of the injurious effects of the scalp act, Dr. C. Hart Merriam, then ornithologist and mammalogist of the United States Department of Agriculture, his assistant, Dr. A. K. Fisher, and Dr. B. H. Warren, examined over three hundred and fifty stomachs of the hawks and owls killed under the act. Ninety-five per cent of the food materials of these birds was found to consist, not of poultry and game, but of "mice and other destructive mammals, grasshoppers and many injurious beetles." Dr. Merriam says, in his report for 1886: "By virtue of this act, about ninety thousand dollars has been paid in bounties during the year and a half that has elapsed since the law went into effect. This represents the destruction of at least 128,571 of the above-mentioned animals, most of which were hawks and owls. Granting that five thousand chickens are killed annually in Pennsylvania by hawks and owls, and that they are worth twenty-five cents each (a liberal estimate, in view of the fact that a large proportion of them are killed when very young), the total loss would be $1,250, and the poultry killed in a year and a half would be worth $1,875. Hence it appears that in the past eighteen months the State of Pennsylvania has expended $90,000 to save its farmers a loss of $1,875. But this estimate by no means represents the actual loss to the farmer and the tax payer of the State." Dr. Merriam then goes on to show the vast loss that must result to the people of Pennsylvania, who, by killing these hawks and owls, have saved the field mice and other harmful creatures on which the birds otherwise would have preyed. The Legislature of Pennsylvania appointed a State ornithologist, and repealed the scalp act. We do not need a "scalp act" in Massachusetts.

Dukes County and the town of Lakeville now pay bounties on hawks and owls. This unwise policy should be discontinued. There are many sections in eastern Massachusetts where hawks and owls are becoming rare. During the winter of 1903–04 many farmers had their young fruit trees ruined by the mice, which ate away the bark. If this continues, a demand for the protection of hawks and owls is sure to come. The placing of a bounty on the few injurious species of hawks has been proposed. No such measure should be enacted, for it would result in the increased killing of all hawks. Moreover, our present law, allowing the destruction of *all* hawks and owls, is in this respect wrong, and should be modified.

Control of the Cat. — As it is almost universally admitted that the cat is one of the greatest enemies of birds, many suggestions have been offered in regard to controlling the pest. The law which prohibits a man from killing certain birds at all times does not prohibit him from keeping any number of cats, and allowing them to run at large, not only killing these same birds, but torturing them as well. In this respect our game laws and bird laws are farcical. But what remedy shall we provide? The cat license finds the most advocates. If a license fee of two dollars or more were demanded for each cat, and a penalty provided for failure to comply with the law, the number of cats soon would be reduced. This would be a distinct advantage. Every man, however, would have to be a self-appointed officer to kill all unlicensed cats, while the licensed cats, being protected by law, would continue to roam the fields and woods with impunity, killing far more birds than licensed dogs do now. With cats unlicensed and in too many cases uncared for, as at present, every sportsman or gunner who is out after game should shoot every cat he sees running at large in the woods. A box trap baited with catnip will capture a large number of cats in the course of a year. This protective device is used by breeders of pheasants and by poultrymen. I have described some cat-proof fences and other devices for protecting birds against cats, in a bulletin on methods of attracting and protecting birds, to be issued by the Hatch Experiment Station at Amherst, Mass.

The suggestion regarding the planting of trees and other plants that will provide both food and shelter for the birds is a good one, which is also treated at some length in the bulletin above referred to.

The Establishment of State Parks for the Preservation of Forests and Game. — This is a policy that is already attracting the attention of the national government and many of the State governments. A protected natural park provides an asylum in which birds can find security from their greatest enemy, man. Here they can find breeding grounds where they will be comparatively unmolested, when, elsewhere, destruction awaits them at every hand. New York State, with her great Adirondack Reservation, has recently established another in the Catskills. Massachusetts already has several reservations of small area. These might be increased in number, and larger tracts of wild land taken. Men of wealth should follow the example of Mr. Corbin, in New Hampshire, and buy up tracts of hill land for the preservation of the forests and the game. In such preserves no shooting of game or birds should be allowed. If birds were protected also against their natural enemies in many preserves of this kind, the supply would be constantly renewed. One or more reservations might be established on our coast for the benefit of water-fowl and shore birds. Parts of Nantucket, Chatham, Monomoy, Wellfleet or other places on Cape Cod, the Ipswich marshes, or some similar resorts of water-fowl and wading birds, might be secured in time to perpetuate the natural features of these bird resorts, and afford the fowl safe feeding ground, upon which they could remain undisturbed indefinitely. We have thus far secured only a few of the beaches near Boston, and these are so frequented by people that most of the birds are driven off; still, a few shore birds may now be seen occasionally along Nahant Neck.

Protection for the Smaller Species that are diminishing. — That portion of the Massachusetts statutes which applies to the smaller birds is very nearly perfect; they are nearly all protected at all times. The unprotected species hardly deserve protection. If the law can be properly enforced, the birds are safe except as they may be interfered with by the changes which take place around the centres of population. The erection of buildings, the laying out of streets, the cutting of trees and shrubbery, the draining of meadows and similar "improvements," the building of trolley roads and telegraph lines, all inimical to bird-life, cannot be helped.

It is probable that in spite of all these agencies the smaller birds can maintain their numbers outside of the immediate influence of the cities. But the question still remains, what shall we do to help the few species that are evidently diminishing under protection?

Of these species, the purple martin is now at the lowest ebb in point of numbers, and most needs such assistance as we may be able to give it in re-establishing itself. I have learned by a voluminous correspondence that many of the empty bird-houses were visited either in spring or fall by migrating martins. In this correspondence one significant fact appeared. Very few people had taken the trouble to clean out the martin-boxes, and remove the old nests, rubbish and dead birds. Mr. Fred B. Pike of Cornish, Me., writes that many of the bird-houses in that region were "full of dead birds from last year's storm," and the martins did not go into them to breed; but in his bird-house, in which there were no dead birds, the martins bred as usual. Mr. Herbert Moulton, Hiram, Me., writes that he took his bird-house down in the spring (1904) and cleaned it out, finding five or six dead birds in some of the rooms. He then put the house on a pole thirty-five feet high, and it was occupied by twelve birds, among which were three females, which raised large broods, thus re-establishing the colony. Not one of the other bird-houses in the vicinity was occupied. If every one owning a martin-box would clean it out annually before the last week in April, the chances of the birds' re-establishing themselves might be bettered. The English sparrows must be kept out of the houses, for when they once get the rooms filled with their bulky nests and pugnacious bodies, the few martins now left will have little chance for a home.

Mrs. Mary R. Stanley writes from North Attleborough of a plan which she thinks will keep out English sparrows from martin-boxes. She speaks of some old dwelling houses where holes underneath the jet were made, affording the birds access to the space under the eaves. These, she says, were used by martins, and have never been used by the sparrows. She suggests making martin-boxes with all the entrances underneath, and without perches, believing that the sparrows will not enter them. The experiment might be worth trying, for every promising means should be used to entice migrating martins to remain and breed. Every householder suitably located should put up at least one small martin-box on a pole not less than twenty feet high. Then, whenever the martins north or south of Massachusetts have a good breeding season, we shall be ready to take care of the overflow.

Barn swallows may be fostered by keeping the old-fashioned barns and sheds open (or at least one open window in each). Round or rough-hewn rafters furnish supporting points for their nests. Small blocks nailed up on modern squared rafters, or slats nailed across them, will assist these swallows in building. The eave swallows may be helped by nailing a rough board on the outside of the building, about a foot below where the eaves or jet meet the wall. The only nest of this species that I saw in Bristol County last year was built on the ledge over the door of a painted barn.

Tree swallows need no assistance beyond being supplied with an abundance of small nesting-boxes, widely separated and put up on poles or trees. If the English sparrow can be kept away from the nesting-boxes, the swallows will breed well.

We may help the house wren a little by putting up small nesting boxes with the entrance hole no larger than a silver quarter. The small size of the entrance probably will serve to keep out the sparrow.

The mourning dove is now fully protected by law, at all times, in Maine, New Hampshire, Massachusetts, Vermont, Rhode Island, Connecticut, New York, New Jersey, Delaware, the District of Columbia and Virginia. In the other Atlantic Coast States it is still on the game list. On one occasion in 1904 in Concord I saw twelve birds flying up a meadow. A single shot was fired at them by some one, and the flock came back; but there were only eleven birds remaining. The laws which protect this species at all times are comparatively recent, and are not as yet generally known and respected. These doves are always shot without restraint in fall and winter in the southern States. They must be given better protection both north and south, as they appear to be decreasing quite generally.

RECAPITULATION AND CONCLUSION.

The Decrease of Species.

1. The action of the elements in 1903–04 was very disastrous to three species only, — the purple martin, the bob-white or quail, and the long-billed marsh wren. The sportsmen are making an effort to restock the covers with quail, but they meet with indifferent success in obtaining birds. The martins appear to be nearly extinct in the breeding season; only a few pairs are left in a few localities. The marsh wrens appear to be nearly exterminated or driven out locally. The chimney swifts suffered greatly, and the swallows to a less degree; Carolina rails and Virginia rails also suffered much. Other species suffered much locally and some quite generally, but a good breeding season in 1904 has done much to efface the effects of the storms.

2. The accounts of early historians show that game birds, water-fowl and shore birds were wonderfully abundant during the settlement of Massachusetts. Since then at least six species have disappeared, and several others are nearly extirpated or driven out, — some quite recently. Among the latter are the long-billed curlew, the Eskimo curlew, the golden plover, the lesser snow goose and the passenger pigeon. The wood duck, the Bartramian sandpiper or upland plover, the knot and the dowitcher are also disappearing rapidly.

The river ducks have decreased steadily, but the bay and sea ducks are still numerous, with few exceptions. Shore birds generally have lessened in number about 75 per cent within the memory of living men.

Eagles appear to be rare or decreasing in nearly all sections. The larger hawks and owls have diminished much in most of eastern Massachusetts; but the decrease of hawks and owls has been only local in the central and western parts of the State, where they are generally at least holding their own.

Great blue herons probably rarely breed now in the State, and other herons seem to have diminished somewhat generally, although in some sections their numbers seem subject to little change. The night herons have recently increased in numbers where the heronries have been protected.

Crows, while fluctuating much, have generally held their own, and in many sections have increased in numbers. Mourning doves have decreased, and are generally rare or wanting except in some eastern sections. There are some indications, however, that they may be increasing now in a few localities.

The smaller native birds fluctuate, some species decreasing in some localities and increasing in others, but apparently holding their own very well, in general. There may be a slight decrease in the aggregate, owing to the evident diminution of many species in and near the cities, with no corresponding increase in the country. There appears to be no general and noticeable reduction in the rural sections except where the birds are subjected to an unusual amount of persecution. On the whole, the balance of life among the smaller birds seems to be fairly maintained.

Swallows seem to have diminished somewhat generally, but more especially in and near the cities and larger towns. In the rural districts the cliff, or eave, swallow shows the greatest diminution, and the tree swallow the least.

Nighthawks have decreased much sectionally. The house wren has become very local, and is now rare or wanting in most localities where it was formerly common. The red-headed woodpecker has practically disappeared as a summer resident. On the other hand, the rose-breasted grosbeak now occupies more territory than formerly, and the robin and bluebird have increased within a few years.

Information received from other States along the Atlantic seaboard seems to indicate that, as here, shore birds and game birds are decreasing, while the insectivorous birds are, with some exceptions, holding their own.

The Chief Causes of the Reduction in Birds' Numbers.

Most important of all is man, — sportsmen, Italians and other foreigners, bird shooters and trappers, market hunters, boy gunners, egg collectors, and certain changes incident to an increase of population.

Secondary Causes of Bird Diminution.

Natural Enemies. — These do not, under natural conditions, reduce the numbers of birds, as they protect the species on which they prey; but certain introduced species have become very harmful. The domestic cat and the English sparrow (the sparrow in particular) are mainly responsible for the disappearance of swallows, wrens and other species near the cities. The sparrow, while not now increasing in or near Suffolk County, seems to be increasing and spreading in the country districts. If this continues, a further diminution in the numbers of native birds is likely to result.

Native natural enemies of birds may become harmful when protected by man from their own enemies. We have protected crows and foxes in some measure by destroying the larger birds and mammals which fed on them, and they have become numerous enough in some localities to be injurious to the already reduced game birds and the song birds.

Suggestions for the Better Protection of Birds.

First and most important, teach the people the economic value of birds, and show the consequences that are likely to follow their extirpation. This should begin in the schools, by interesting the children in the lives of birds, teaching their usefulness, and how to feed, shelter and protect them. The children should also be instructed in regard to the laws protecting birds, and be taught to respect them. The bird and game laws must be enforced, even if it requires larger appropriations for the Fish and Game Commission, with the appointment of more paid deputies. In this connection a law licensing shooters, the license fees to be applied to the enforcement of the game laws, may be worth considering. The officers of the Fish and Game Commission should be given the right to search suspected persons. Until such a measure is enacted, the game laws can never be enforced as they should be.

Those birds which, like the wood duck, are disappearing, should be protected at all times by law. All spring and summer shooting of wild-fowl and shore birds should be, and eventually must be, prohibited by law.

If it shall be found that these measures do not give sufficient protection, then the sale of all birds from Massachusetts sources must be prohibited. All persons and all associations interested in bird protection should unite to hold up the hands of those who are now working to secure the protection of birds in the south during the winter and spring.

The extirpation of a species usually takes a long time, and only those species which are the objects of special and unremitting persecution throughout their range are likely ever to be eradicated from the country. For this reason, our "song and insectivorous birds," which are here protected by law, will be comparatively safe when the law is fully enforced. But it is not so difficult practically to exterminate or to drive out of a State a migrant or a resident game bird; therefore, the game birds, the shore birds and all others that are readily accessible and are killed for food or sport must now be protected by the most stringent laws, most rigidly enforced, or eventually they will be swept from the territory of this Commonwealth.

APPENDIX.

Massachusetts Correspondents who furnished Information for this Report.

Berkshire County.

Bidwell, Wm. S.,	Monterey.
Bradley, Alonzo,	Lee.
Carne, Mrs. Thos.,	Forest Park, Adams.
Cross, W. J.,	Becket.
Dewey, Harvey H.,	New Lenox.
Northup, L. J.,	Cheshire.
O'Neill, Francis,	Adams.
Ruberg, L. E.,	Florida.

Salmon, Timothy B.,	Richmond.
Snow, W. H.,	Becket.
Stearns, W. R.,	Pittsfield.
Van Huyck, J. M.,	Lee.
Wood, J. H.,	Pittsfield.

Hampshire County.

Baker, N. B.,	West Chesterfield.
Brewer, J. L.,	Pelham.
Brooks, Prof. Wm. P.,	Amherst.
Eldredge, A. H.,	Ware.
Fernald, Dr. H. T.,	Amherst.
Lyman, C. B.,	Southampton.
Nelligan, Prof. R. F.,	Amherst.
Nichols, A. W.,	Chesterfield.
Pratt, A. L.,	Belchertown.
Richards, F. C.,	Williamsburg.
Russell, H. C.,	North Hadley.
Sornborger, M. L.,	Haydenville.

Hampden County.

Adams, Miss Emily B.,	Springfield.
Bagg, J. N.,	West Springfield.
Bemis, R. W.,	Chicopee Falls.
Clark, E. C.,	Wilbraham.
Fairfield, Mrs. S. L.,	Monson.
Healey, M. C.,	Thorndike.
Hendrick, J. H.,	Springfield.
Luman, J. F.,	Palmer.
Marsh, Daniel J.,	Springfield.
Morris, Robert O.,	Springfield.
Rogers, F. D.,	Monson.
Sanford, Mrs. Fred. A.,	Westfield.
Scott, F. H.,	Westfield.
White, C. A.,	Ludlow Centre.

Franklin County.

Allen, Thos.,	Bernardston.
Ballard, Daniel,	Millington.
Cushman, R. H.,	Bernardston.
Howard, Anson O.,	East Northfield.
Nims, Miss Clara W.,	Greenfield.
Russell, Chas. C.,	Greenfield.
Smith, A. A.,	Lyonsville.
Swann, H. W.,	Shelburne Falls.
Wells, H. A.,	Deerfield.
Woffenden, F. W.,	Rowe.

Worcester County.

Allen, Jesse,	Oakham.
Anderson, Geo. M.,	Worcester.
Bothwell, Ethan,	Northborough.
Carkin, Geo. E.,	Royalston.
Casavant, F. S.,	Gardner.
Chase, Guy H.,	Princeton.
Churchill, Miss Abby P.,	Fitchburg.
Durgin, W. F.,	Hopedale.
Fisher, Dr. Jabez,	Fitchburg.
Gibson, C. O.,	Fitchburg.
Hall, Rufus C.,	Webster.
Hodge, Prof. Clifton F.,	Worcester.
Holden, Wm.,	Leominster.
Ingalls, Chas. E.,	East Templeton.
Jefts, A. H.,	Athol.
Kinney, H. R.,	Worcester.
Love, Joseph P.,	Webster.
Mann, Miss J. Ardelle,	Millville.
Martin, J. L.,	Milford.
Perry, Wm. S.,	Worcester.
Proctor, Fred. J.,	Fitchburg.
Prentiss, Wm. N.,	Milford.
Smith, Robert F.,	Uxbridge.
Spalter, Mrs. F. B.,	Winchendon.
Stockwell, S. F.,	Auburn.
Stone, C. E.,	Lunenburg.
Thayer, Col. John E.,	Lancaster.
Tuttle, E. F.,	Uxbridge.*
Warren, D. A.,	Upton.
Whitehead, Geo. E.,	Millbury.
Woodward, Dr. Lemuel F.,	Worcester.

Middlesex County.

Appleton, Miss Augusta I.,	Winchester.
Aspinwall, W. H.,	Chestnut Hill.
Bailey, C. E.,	North Billerica.
Bailey, Dr. J. W.,	Arlington.
Barnard, Mrs. Josephine M.,	Westford.
Brewster, Wm.,	Cambridge.
Comey, A. C.,	Cambridge.
Coolidge, Philip T.,	Watertown.
Douglas, N. B.,	Sherborn.

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* Present address, Franklin, Norfolk County.

Frost, H. G.,	Waltham.
Gerry, Elbridge,	Stoneham.
Hagar, Geo. W.,	Marlborough.
Higginson, A. H.,	South Lincoln.
Hill, Miss Elizabeth S.,	Groton.
Hoffman, Ralph,	Belmont.
Holden, Edward F.,	Melrose.
Hornbrooke, Mrs. F. B.,	Newton.
Hunter, W. J.,	Lincoln.
Kirkland, A. H.,	Reading.
Kohlrausch, C. H., Jr.,	Billerica.
Maynard, C. J.,	Newtonville.
Mills, J. I.,	Ayer.
Parker, Samuel,	Wakefield.
Parkhurst, S. W.,	Chelmsford.
Poland, Geo. M.,	Wakefield.
Price, Chas. P.,	Stoneham.
Randall, Walter B.,	Newton Upper Falls.
Robbins, Miss N. P. H.,	Lowell.
Smith, Henry N.,	South Sudbury.
Snow, H. A.,	Marlborough.
Steele, Walter,	Stoneham.
Symmes, S. S.,	Winchester.
Wheeler, C. S.,	Lincoln.
Wickersham, C. S.,	Cambridge.
Wood, E. W.,	West Newton.

Essex County.

Brown, Gilman W.,	West Newbury.
Burney, Thos. L.,	West Lynn.
Chase, H. F.,	Amesbury.
Dodge, F. C.,	Beverly.
Farley, J. A.,	Lynnfield.
Godfrey, H. L.,	Newburyport.
Goodridge, J. W.,	Wenham.
Goldsmith, G. W.,	Beverly.
Knowlton, F. S.,	Wenham.
Loring, Miss K. P.,	Pride's Crossing.
Nichols, Miss Mary W.,	Hathorne.
Nixon, Wm. W.,	Gloucester.
Perkins, C. L.,	Newburyport.
Pickering, Miss S. W.,	Salem.
Pike, B. P.,	Topsfield.
Pitman, James,	Swampscott.
Prescott, Chas.,	Amesbury.
Robbins, Reginald C.,	Pride's Crossing.

Townsend, Dr. Chas. W.,	Ipswich.
Webster, Eben,	Haverhill.
Wood, Gardner,	Groveland.
Young, Hiram A.,	Beverly.

Suffolk County.

Allen, F. H.,	Boston.
Bangs, Edward A.,	Boston.
Bigelow, Homer L.,	Boston.
Day, Chester S.,	Boston.
Hemmenway, Mrs. Augustus,	Boston.
Kimball, H. H.,	Boston.
Newcomb, H. H.,	Boston.
Shattuck, Geo. C.,	Boston.

Norfolk County.

Baldwin, R. N.,	Wellesley.
Bent, Herbert A.,	Franklin.
Blake, Francis G.,	Brookline.
Brastow, Miss A. M.,	Wrentham.
Burgess, John K.,	Dedham.
Cabot, Louis,	Brookline.
Harris, Samuel,	East Dedham.
Higbee, Harry G.,	Hyde Park.
Horton, I. Chester,	Ponkapog.
Kennard, F. H.,	Brookline.
McKechnie, F. B.,	Ponkapog.
Richards, Miss Harriet E.,	Brookline.
Richardson, John K.,	Wellesley.
Searle, Frank,	Franklin.
Thayer, Otis,	West Quincy.
Webster, Frank B.,	Hyde Park.

Bristol County.

Alger, Isaac,	Attleborough.
Bent, Arthur C.,	Taunton.
Fleck, Miss Effie,	Pottersville.
Mosher, F. H.,	Dartmouth.
Packard, H. R.,	Attleborough.
Proctor, Frank W.,	Fairhaven.
Slade, Elisha,	Somerset.
Stanley, Mrs. Mary R.,	North Attleborough.
Sullivan, James H.,	Westport.
Tinkham, Mrs. Carrie P.,	North Raynham.
Tinkham, H. W.,	Swansea.
Wharmbly, Isaac,	Fall River.
Winter, Wm. C.,	Mansfield.

Plymouth County.

Barnes, Miss Agnes G.,	Plymouth.
Bigelow, Henry B.,	Cohasset.
Bourne, J. H.,	Marshfield.
Brown, Mrs. Walter L.,	Brockton.
Carr, Rufus H.,	Brockton.
Dickson, Chas.,	Plymouth.
Delano, John W.,	Marion.
Dyke, Arthur C.,	Bridgewater.
Kennedy, Mrs. A. M.,	Whitman.
McMenamen, Miss S. E.,	Westdale.
Miles, Mrs. Henry A.,	Hingham.
Shurtleff, Walter D.,	Plymouth.
Southworth, A. C.,	Lakeville.
Thomas, Dr. F. S.,	Hanson.
Valler, I. H.,	Plymouth.

Barnstable County.

Brown, Miss Bertha M.,	Hyannis.
Clark, J. A.,	Eastham.
Day, Chester S.,	Chathamport.
Hammond, W. F.,	Mashpee.
Meigs, Wm.,	South Sandwich.
Nye, D. D.,	Bourne.

Nantucket County.

Dunham, W. C.,	Nantucket.
Mackay, Geo. H.,	Nantucket.

Dukes County.

Look, James,	West Tisbury.

Correspondents from Other States.

Maine.

Moulton, Herbert,	Hiram.
Pike, Fred,	Cornish.

New Hampshire.

Lane, G. W.,	Chichester.
Thayer, Abbot H.,	Monadnock.

Vermont.

Barber, Dr. Geo. F.,	Brattleboro'.
Davenport, Mrs. E. B.,	Brattleboro'.
Perkins, Dr. G. H.,	Burlington.
Votey, Prof. J. W.,	Burlington.

Rhode Island.

Burdick, H. Hillyer,	Quonochontaug.
Hathaway, H. S.,	Providence.
Lewis, Edwin R.,	Westerly.
Mearns, Dr. Edgar A.,	Newport.

Connecticut.

Curtiss, Robert W.,	Stratford.
Geer, E. Hart,	Hadlyme.
Wright, Mrs. Mabel O.,	Fairfield.

New York.

Roosevelt, Theodore,	Oyster Bay, L. I.

New Jersey.

Chapman, Frank M.,	Englewood.

Pennsylvania.

Pennock, Prof. C. J.,	Kennet Square.

District of Columbia.

Palmer, Dr. T. S.,	Washington.

FINANCIAL RETURNS

AND

ANALYSIS OF PREMIUMS AND GRATUITIES

OF THE

INCORPORATED SOCIETIES.

WITH MEMBERSHIP AND INSTITUTES,

FOR THE YEAR 1904.

FINANCIAL RETURNS OF THE INCORPORATED

	SOCIETIES.	When Incorporated.	Amount originally raised by Contribution. (R. L. 124, Sects. 1 and 3.)	Amount now held as Invested Capital Stock. (R. L. 124, Sects. 3 and 12.)	Estimated Market Value of Property.	Total Assets.
1	Amesbury and Salisbury (Agricultural and Horticultural), .	1881	$1,002 32	[2] $8,126 77	$8,126 77	$8,383 30
2	Barnstable County, ...	1844	1,740 00	[3] 8,300 00	8,300 00	10,715 00
3	Blackstone Valley, ...	1884	3,000 00	[2] 4,500 00	4,500 00	4,512 39
4	Bristol County, ...	1823	8,240 00	[4] 32,000 00	32,400 00	32,419 83
5	Deerfield Valley, ...	1871	4,094 01	[4] 9,200 00	9,450 00	9,450 00
6	Eastern Hampden, ...	1856	3,000 00	[4] 7,000 00	7,000 00	7,012 97
7	Essex, ...	1818	4,547 20	[5] 23,559 53	23,559 53	23,559 53
8	Franklin County, ...	1850	3,768 00	[6] 9,000 00	9,000 00	9,042 74
9	Hampshire, ...	1850	3,255 26	[7] 5,098 64	5,000 00	5,098 64
10	Hampshire, Franklin and Hampden, ...	1818	8,141 29	[8] 3,802 40	3,802 40	3,802 40
11	Highland, ...	1859	3,262 00	[2] 3,262 00	3,262 00	3,264 52
12	Hillside, ...	1883	3,113 32	[9] 5,800 00	5,800 00	5,932 82
13	Hingham (Agricultural and Horticultural), ...	1867	17,406 15	[10] 5,377 69	5,377 69	5,377 69
14	Housatonic, ...	1848	6,335 33	[11] 24,750 62	25,175 62	26,216 93
15	Marshfield (Agricultural and Horticultural), ...	1867	3,755 48	[2] 14,050 00	14,050 00	14,411 60
16	Martha's Vineyard, ...	1859	4,552 17	[12] 4,298 34	4,298 34	4,298 34
17	Massachusetts Horticultural, .	1829	525 00	[13] 564,524 70	848,181 96	848,181 96
18	Massachusetts Society for Promoting Agriculture,[1]	1792	-	-	-	-
19	Middlesex North, ...	1855	3,000 00	[2] 50,700 00	50,700 00	51,350 24
20	Middlesex South, ...	1854	3,000 00	[2] 12,200 00	12,200 00	12,248 13
21	Nantucket, ...	1856	3,500 00	[4] 3,200 00	3,200 00	3,275 36
22	Oxford, ...	1888	4,400 00	[14] 8,943 18	8,943 18	8,943 18
23	Plymouth County, ...	1819	9,550 00	[15] 1,536 67	1,534 15	1,536 67
24	Spencer (Farmers' and Mechanics' Association), ...	1888	4,084 00	[2] 8,950 00	8,950 00	9,099 55
25	Union (Agricultural and Horticultural), ...	1867	4,447 23	[2] 9,000 00	9,000 00	9,000 00
26	Weymouth (Agricultural and Industrial), ...	1891	10,270 00	[2] 11,270 00	11,270 00	11,481 88
27	Worcester, ...	1818	7,730 00	[16] 89,687 14	89,687 14	89,687 14
28	Worcester East, ...	1890	2,296 23	[14] 7,449 49	7,449 49	7,449 49
29	Worcester Northwest (Agricultural and Mechanical), . .	1867	3,400 00	[2] 13,600 00	13,600 00	13,918 52
30	Worcester South, ...	1855	3,127 40	[2] 11,400 00	11,400 00	11,467 51
31	Worcester County West, . .	1851	3,175 00	[2] 13,600 00	13,600 00	13,667 64
			$138,673 34	$974,187 17	$1,258,818 27	$1,264,805 97

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[1] Represented on the Board by special enactment, and makes no returns.

[2] Invested in real estate, crockery, tables, etc.

[3] Invested in real estate and bonds.

[4] Invested in real estate.

[5] Invested in real estate, stocks, cash, crockery, tables, etc.

[6] Invested in real estate and stocks.

[7] Invested in real estate, bills due and cash.

[8] Invested in real estate, stocks, bank funds, crockery, tables, etc.

SOCIETIES FOR THE YEAR ENDING DEC. 31, 1904.

Real Estate.	Notes.	Stocks and Bonds.	Bank Funds.	Bills due and unpaid.	Crockery, Tables, etc.	Cash on Hand.	Total Liabilities.	
$7,721 49	-	-	-	$161 00	$405 28	$95 53	$2,161 00	1
7,500 00	-	$800 00	-	1,800 00	-	615 00	-	2
4,400 00	-	-	-	7 00	100 00	5 39	2,040 75	3
32,000 00	-	-	-	-	400 00	19 83	19,699 25	4
9,200 00	-	-	-	-	250 00	-	84 81	5
7,000 00	-	-	-	3 25	-	9 72	6,898 67	6
15,300 00	-	7,805 00	-	-	200 00	254 53	10,277 95	7
8,000 00	-	1,000 00	-	40 00	-	2 74	6,525 00	8
5,000 00	-	-	-	42 00	-	56 64	1,874 16	9
600 00	-	112 50	$2,189 90	-	900 00	-	-	10
3,000 00	-	-	-	-	262 00	2 52	-	11
5,000 00	-	-	450 00	-	350 00	132 82	-	12
3,000 00	-	-	-	977 20	1,000 00	400 49	-	13
22,000 00	-	1,000 00	1,750 62	25 00	425 00	1,016 31	7,412 00	14
13,300 00	-	-	-	-	750 00	361 60	2,363 35	15
2,750 00	$200 00	-	-	-	250 00	1,098 34	169 57	16
559,465 49	-	263,238 50	12,388 80	3,488 76	9,600 41	-	6,470 00	17
-	-	-	-	-	-	-	19,740 69	18
50,000 00	-	-	-	480 84	700 00	169 40	7,927 83	19
12,000 00	-	-	-	-	200 00	48 13	572 94	20
3,200 00	-	-	-	85 00	-	40 36	-	21
7,600 00	-	-	-	-	200 00	1,143 18	-	22
-	-	-	1,479 15	-	37 00	2 52	2,150 00	23
8,000 00	-	-	-	-	950 00	149 55	1,338 32	24
8,000 00	-	-	-	-	1,000 00	-	2,400 00	25
11,000 00	-	-	-	-	270 00	211 88	1,405 83	26
58,000 00	-	-	30,000 00	184 16	1,464 50	38 48	-	27
7,297 88	-	-	76 61	-	75 00	-	3,300 00	28
13,000 00	-	-	-	-	600 00	318 52	-	29
11,100 00	-	-	-	-	300 00	67 51	2,695 95	30
12,600 00	-	-	-	-	1,000 00	67 64	800 00	31
$907,084 86	$200 00	$273,956 00	$48,353 08	$7,244 21	$21,669 19	$6,328 63	$108,308 07	

[9] Invested in real estate, bank funds, crockery, tables, etc.
[10] Invested in real estate, bills due, cash, crockery, tables, etc.
[11] Invested in real estate, stocks and bank funds.
[12] Invested in real estate, notes, bank funds, crockery, tables, etc.
[13] Invested in real estate, library, furniture, bonds and other securities.
[14] Invested in real estate, cash, crockery, tables, etc.
[15] Invested in bank funds, crockery, tables, etc.
[16] Invested in real estate, bank funds, bills due, cash, crockery, tables, etc.

Financial Returns of the Incorporated Societies

	SOCIETIES.	Premiums due and unpaid.	Outstanding Bills.	Mortgages or Like Liabilities.	Total Receipts.	Bounty.	Income from Notes and Bank Funds.
1	Amesbury and Salisbury (Agricultural and Horticultural), .	-	$161 00	$2,000 00	$1,632 30	$600 00	-
2	Barnstable County, ...	-	-	-	8,520 77	600 00	-
3	Blackstone Valley, ...	-	105 00	1,935 75	1,163 11	518 10	-
4	Bristol County, ...	$199 25	2,000 00	17,500 00	13,539 59	600 00	-
5	Deerfield Valley, ...	-	84 81	-	1,968 25	600 00	-
6	Eastern Hampden, ...	-	574 22	6,324 45	4,761 07	600 00	-
7	Essex, ...	-	-	10,277 95	3,017 60	600 00	-
8	Franklin County, ...	-	175 00	6,350 00	6,001 06	600 00	-
9	Hampshire, ...	-	101 16	1,773 00	1,314 83	600 00	-
10	Hampshire, Franklin and Hampden, ...	-	-	-	4,088 47	600 00	$71 93
11	Highland, ...	-	-	-	1,729 75	600 00	-
12	Hillside, ...	-	-	-	1,616 22	600 00	20 00
13	Hingham (Agricultural and Horticultural), ...	-	-	-	2,354 91	600 00	100 00
14	Housatonic, ...	-	[3] 50 00	7,362 00	11,120 17	600 00	36 09
15	Marshfield (Agricultural and Horticultural), ...	23 25	-	2,340 10	4,401 08	600 00	-
16	Martha's Vineyard, ...	6 00	163 57	-	1,051 89	600 00	54 79
17	Massachusetts Horticultural, .	[2] 6,470 00	-	-	18,853 38	600 00	249 91
18	Massachusetts Society for Promoting Agriculture,[1] . . .	-	-	-	-	-	-
19	Middlesex North, ...	59 85	480 84	19,200 00	7,323 49	600 00	-
20	Middlesex South, ...	-	77 83	7,850 00	1,351 26	600 00	-
21	Nantucket, ...	-	572 94	-	1,273 07	600 00	-
22	Oxford, ...	-	-	-	3,749 43	600 00	25 00
23	Plymouth County, ...	-	-	-	247 00	200 00	26 25
24	Spencer (Farmers' and Mechanics' Association), ...	-	-	2,150 00	3,975 92	600 00	-
25	Union (Agricultural and Horticultural), ...	-	88 82	1,300 00	1,954 00	600 00	-
26	Weymouth (Agricultural and Industrial), ...	-	-	2,400 00	4,443 97	600 00	-
27	Worcester, ...	-	1,405 88	-	25,033 85	600 00	1,361 63
28	Worcester East, ...	-	-	-	8,918 67	600 00	14 14
29	Worcester Northwest (Agricultural and Mechanical), . .	-	-	3,300 00	7,564 01	600 00	-
30	Worcester South, ...	52 25	93 70	2,550 00	4,588 69	600 00	-
31	Worcester County West, . .	-	-	800 00	3,172 25	600 00	-
		$6,810 60	$6,084 22	$95,413 25	$160,700 01	$17,518 10	$1,959 73

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[1] Represented on the Board by special enactment, and makes no returns.

FOR THE YEAR ENDING DEC. 31, 1904 — *Concluded.*

Income from Stocks and Bonds.	Received from New Members.	Received as Donations.	Received from All Other Sources.	Total Expenditures.	Premiums and Gratuities paid.	Current Running Expenses.	Interest.	All Other Expenses.	
-	-	-	$1,032 30	$1,265 12	$625 90	$639 22	-	-	1
$20 00	$15 00	$1,062 78	6,832 99	7,905 77	1,769 05	-	-	$6,136 72	2
-	8 00	-	637 01	1,149 72	547 50	-	$32 50	569 72	3
-	40 00	-	12,899 59	13,519 67	4,648 25	7,165 17	706 25	1,000 00	4
-	26 00	8 25	1,304 00	1,930 00	1,117 26	782 37	3 18	27 19	5
-	45 00	66 41	4,049 66	4,751 35	809 21	2,344 31	325 79	1,272 04	6
486 97	51 00	-	1,879 63	2,767 28	[4] 1,490 30	671 09	541 39	64 50	7
40 00	-	4 00	5,357 06	5,798 32	1,218 45	3,623 87	306 00	650 00	8
-	32 50	132 25	550 08	1,810 87	609 38	691 60	83 01	426 88	9
-	72 00	-	3,344 55	3,915 33	1,085 50	-	-	2,829 83	10
-	61 00	-	1,068 75	1,727 23	691 00	335 18	4 00	697 05	11
-	91 50	19 08	885 64	1,408 50	885 88	364 06	-	158 56	12
-	1 00	13 05	1,640 86	2,110 70	577 20	638 90	23 33	871 27	13
55 00	131 34	-	10,297 74	10,103 86	4,440 75	3,952 82	327 50	1,382 79	14
-	10 00	-	3,791 08	3,779 43	1,203 05	2,122 04	454 34	-	15
-	10 00	-	387 10	1,155 66	611 76	328 18	-	215 72	16
10,799 00	1,036 00	1,176 99	4,991 48	21,995 60	[4] 5,522 55	13,934 83	-	2,538 22	17
-	-	-	-	-	-	-	-	-	18
-	28 00	-	6,695 49	7,154 09	1,336 90	1,699 83	860 54	3,256 82	19
-	8 25	-	743 01	1,327 78	803 25	472 28	52 25	-	20
-	22 00	-	651 07	1,244 81	605 75	639 06	-	-	21
-	16 00	5 00	3,103 43	2,606 25	1,268 63	582 73	-	754 89	22
-	-	-	20 75	266 45	211 50	55 04	-	-	23
-	15 00	362 72	2,998 20	3,862 47	1,143 25	2,501 72	10 00	207 50	24
-	21 00	-	1,383 00	1,992 32	1,185 98	761 47	22 12	22 75	25
-	20 00	-	3,828 97	4,282 09	787 45	150 00	84 87	3,259 77	26
-	60 00	-	23,012 22	25,419 55	6,330 66	9,148 66	26 55	9,913 68	27
-	40 00	1,352 00	6,912 53	9,384 16	1,657 05	7,539 04	-	188 07	28
-	5 00	-	6,959 01	7,245 49	3,331 45	3,711 64	202 40	-	29
-	77 00	-	3,911 69	5,085 79	1,913 25	2,666 97	117 50	388 07	30
-	50 00	10 77	2,511 48	3,778 80	1,715 03	2,029 15	34 62	-	31
$11,400 97	$1,992 59	$4,208 80	$123,625 32	$160,664 55	$50,078 14	$69,536 23	$4,218 14	$36,832 04	

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[2] Awarded in 1904; to be paid in 1905.

[3] Estimated.

[4] Awarded in 1903.

ANALYSIS OF PREMIUMS AND GRATUITIES, MEMBERSHIP AND

	SOCIETIES.	Total Amount offered in Premiums.	Total Amount awarded in Premiums and Gratuities.	Total Amount paid in Premiums and Gratuities.	Amount offered under Head of Farms, etc.	Amount awarded under Head of Farms, etc.	Amount paid under Head of Farms, etc.	Amount offered under Head of Farm and Pet Stock.
1	Amesbury and Salisbury (Agricultural and Horticultural), ...	$1,200 00	$708 30	$625 90	-	-	-	$500 00
2	Barnstable County, . .	2,175 75	1,769 05	1,769 05	$48 00	$5 00	$5 00	634 25
3	Blackstone Valley, . .	999 90	547 50	547 50	135 00	29 00	29 00	675 50
4	Bristol County, . . .	5,150 00	4,846 50	4,648 25	25 00	-	-	1,150 00
5	Deerfield Valley, . . .	1,477 95	1,135 51	1,117 26	-	-	-	848 00
6	Eastern Hampden, . .	977 45	863 11	809 21	55 00	16 00	16 00	664 00
7	Essex, ...	2,211 00	1,285 10	[2] 1,490 30	-	-	-	1,244 00
8	Franklin County, . . .	1,412 00	1,218 85	1,213 45	-	-	-	1,000 00
9	Hampshire, ...	1,318 00	708 00	609 38	25 00	-	-	909 00
10	Hampshire, Franklin and Hampden, ...	1,624 00	1,188 50	1,065 50	50 00	-	-	1,018 00
11	Highland, ...	774 15	691 00	691 00	-	-	-	379 00
12	Hillside, ...	910 00	885 88	885 88	-	-	-	578 00
13	Hingham (Agricultural and Horticultural), . . .	1,372 75	577 20	577 20	92 75	-	-	-
14	Housatonic, ...	5,000 00	4,440 75	4,440 75	-	-	-	1,672 50
15	Marshfield (Agricultural and Horticultural), . .	1,488 50	1,226 30	1,203 05	120 00	-	-	277 50
16	Martha's Vineyard, . .	888 90	627 56	611 76	39 00	5 00	5 00	460 00
17	Massachusetts Horticultural,	7,349 00	5,901 00	[2] 5,522 55	557 00	347 00	[2] 538 64	-
18	Massachusetts Society for Promoting Agriculture,[1] .	-	-	-	-	-	-	-
19	Middlesex North, . . .	1,212 10	789 50	[2] 1,336 90	-	-	-	575 75
20	Middlesex South, . . .	1,710 20	806 25	808 25	45 00	12 00	8 00	827 00
21	Nantucket, ...	1,400 00	605 75	605 75	96 00	12 00	12 00	690 00
22	Oxford, ...	1,600 00	1,295 90	1,268 63	78 00	34 50	34 50	874 00
23	Plymouth County, . . .	275 00	211 50	211 50	75 00	-	-	-
24	Spencer (Farmers' and Mechanics' Association), .	1,400 00	1,143 25	1,143 25	27 00	23 00	23 00	984 25
25	Union (Agricultural and Horticultural), . . .	1,614 35	1,210 30	1,185 98	-	-	-	813 50
26	Weymouth (Agricultural and Industrial), . . .	1,172 15	880 25	737 45	-	-	-	679 00
27	Worcester, ...	7,502 25	6,330 66	6,330 66	-	-	-	4,804 00
28	Worcester East, . . .	2,573 75	1,657 05	1,657 05	32 00	26 00	26 00	1,556 00
29	Worcester Northwest (Agricultural and Mechanical), .	3,686 65	3,407 65	3,331 45	21 00	-	-	1,471 75
30	Worcester South, . . .	2,450 00	1,964 70	1,913 25	138 00	42 00	42 00	956 00
31	Worcester County West, .	2,023 20	1,925 80	1,715 03	57 00	26 00	26 00	820 00
		$64,849 00	$50,788 67	$50,078 14	$1,715 75	$577 50	$765 14	$27,001 00

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[1] Held no fair and made no report.

[2] Awarded in 1903.

INSTITUTES, FOR THE YEAR ENDING DEC. 31, 1904.

Amount awarded under Head of Farm and Pet Stock.	Amount paid under Head of Farm and Pet Stock.	Amount offered under Head of Field and Garden Crops.	Amount awarded under Head of Field and Garden Crops.	Amount paid under Head of Field and Garden Crops.	Amount offered under Head of Farm and Garden Products.	Amount awarded under Head of Farm and Garden Products.	Amount paid under Head of Farm and Garden Products.	Amount offered under Head of Dairy Products.	Amount awarded under Head of Dairy Products.	
$240 50	$223 50	-	-	-	$300 00	$165 10	$136 10	-	-	1
444 30	444 30	$182 00	$40 75	$40 75	321 00	227 05	227 05	$10 00	$10 00	2
376 30	376 30	-	-	-	115 50	82 50	82 50	10 00	3 00	3
1,007 90	858 65	-	-	-	250 00	226 15	216 15	25 00	10 00	4
629 56	622 06	-	-	-	128 50	85 90	85 15	12 00	9 00	5
632 50	632 50	-	-	-	133 25	92 50	92 50	49 00	49 00	6
599 00	[3] 794 00	63 00	7 00	[3] 8 00	500 00	388 25	[3] 384 00	-	-	7
896 00	896 00	-	-	-	250 00	191 85	191 85	22 00	10 00	8
360 00	317 00	-	-	-	132 00	106 00	87 00	13 00	2 00	9
929 00	848 25	89 00	19 00	17 50	193 00	152 00	144 63	36 00	9 00	10
421 75	421 75	35 00	18 50	18 50	61 50	63 80	63 80	5 00	5 00	11
514 15	514 15	60 00	55 00	55 00	93 50	71 65	71 65	11 00	7 25	12
-	-	131 00	10 00	10 00	915 75	445 05	445 05	3 50	3 75	13
1,150 86	1,150 86	268 00	253 00	253 00	853 00	814 50	814 50	42 00	42 00	14
291 35	281 10	90 50	3 00	3 00	201 75	140 00	127 10	9 50	5 00	15
266 25	266 25	151 15	41 00	41 00	34 00	92 11	92 11	13 00	15 60	16
-	-	-	-	-	6,792 00	5,554 00	[3] 4,963 91	-	-	17
-	-	-	-	-	-	-	-	-	-	18
378 75	342 00	405 85	206 90	196 30	4 50	-	-	4 50	-	19
179 75	156 25	42 00	-	-	180 20	75 50	75 50	-	-	20
331 50	331 50	143 00	-	-	127 00	61 75	61 75	16 00	-	21
555 00	540 25	-	-	-	-	-	-	12 00	7 25	22
-	-	-	-	-	138 25	127 75	127 75	-	-	23
780 25	780 25	-	-	-	232 50	139 00	139 00	25 00	25 00	24
514 75	502 75	-	-	-	68 50	50 45	48 20	13 25	10 25	25
389 10	348 15	46 00	22 00	19 00	210 00	197 35	185 65	85 00	50 00	26
3,306 00	3,306 00	-	-	-	527 00	494 50	494 50	29 00	15 00	27
911 25	911 25	-	-	-	815 50	270 75	270 75	21 00	8 00	28
1,028 75	1,018 75	-	-	-	274 10	152 25	150 25	18 00	7 00	29
711 00	675 00	-	-	-	191 25	153 05	119 30	22 00	20 00	30
699 00	694 00	-	-	-	144 45	107 95	102 18	15 00	12 00	31
$18,544 52	$18,252 82	$1,706 50	$676 15	$662 05	$13,188 00	$10,230 71	$9,519 88	$521 75	$371 35	

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[3] Awarded in 1903 and 1904.

ANALYSIS OF PREMIUMS AND GRATUITIES, MEMBERSHIP AND

	SOCIETIES.	Amount paid under Head of Dairy Products.	Amount offered under Head of Domestic Manufactures.	Amount awarded under Head of Domestic Manufactures.	Amount paid under Head of Domestic Manufactures.	Amount awarded under Head of Miscellaneous.	Amount paid under Head of Miscellaneous.
1	Amesbury and Salisbury (Agricultural and Horticultural), .	-	$200 00	$120 20	$103 50	$182 50	$162 50
2	Barnstable County, ...	$10 00	133 00	234 50	234 50	29 50	29 50
3	Blackstone Valley, ...	3 00	33 50	26 20	26 20	30 50	30 50
4	Bristol County, ...	10 00	300 00	209 20	179 20	148 25	133 25
5	Deerfield Valley, ...	9 00	95 20	69 30	69 30	41 75	41 75
6	Eastern Hampden, ...	49 00	63 75	55 11	55 11	18 00	-
7	Essex, ...	-	204 00	124 85	[2] 150 05	166 00	[2] 198 50
8	Franklin County, ...	10 00	125 00	108 60	108 60	15 00	15 00
9	Hampshire, ...	2 00	56 00	50 00	44 38	183 00	159 00
10	Hampshire, Franklin and Hampden, ...	9 00	76 00	42 25	87 37	37 25	28 75
11	Highland, ...	5 00	55 55	61 35	61 35	45 60	45 60
12	Hillside, ...	7 25	100 00	108 65	103 65	64 76	64 76
13	Hingham (Agricultural and Horticultural), ...	3 75	128 75	70 95	70 95	47 45	47 45
14	Housatonic, ...	42 00	513 00	317 80	317 80	-	-
15	Marshfield (Agricultural and Horticultural), ...	5 00	95 00	78 00	75 25	29 95	29 95
16	Martha's Vineyard, ...	15 60	96 75	118 80	118 80	83 80	84 80
17	Massachusetts Horticultural, .	-	-	-	-	-	-
18	Massachusetts Society for Promoting Agriculture,[1] . . .	-	-	-	-	-	-
19	Middlesex North, ...	-	125 50	78 00	14 00	-	-
20	Middlesex South, ...	-	106 00	30 00	30 00	30 00	30 00
21	Nantucket, ...	-	128 00	57 75	57 75	42 75	42 75
22	Oxford, ...	7 25	76 50	45 25	40 68	11 95	11 95
23	Plymouth County, ...	-	81 75	68 75	68 75	15 00	15 00
24	Spencer (Farmers' and Mechanics' Association), ...	25 00	61 50	57 00	57 00	119 00	119 00
25	Union (Agricultural and Horticultural), ...	10 25	126 20	109 65	100 70	141 70	141 08
26	Weymouth (Agricultural and Industrial), ...	50 00	175 15	146 95	144 40	39 75	39 75
27	Worcester, ...	15 00	49 75	46 25	46 25	264 50	264 50
28	Worcester East, ...	8 00	211 95	126 30	126 30	187 75	187 75
29	Worcester Northwest (Agricultural and Mechanical), . . .	7 00	81 25	51 15	44 60	48 00	43 00
30	Worcester South, ...	20 00	76 25	58 90	56 90	29 75	28 25
31	Worcester County West, . . .	12 00	69 75	50 85	50 85	-	-
		$335 10	$3,645 05	$2,707 56	$2,589 14	$2,048 46	$1,989 34

[1] Held no fair and made no report.

[2] Awarded in 1903.

[3] Net cost.

[4] And gratuities.

INSTITUTES, FOR THE YEAR ENDING DEC. 31, 1904 — *Concluded.*

Amount paid for Trotting.	Number of Persons receiving Premiums.	Number of Persons receiving Gratuities.	Number of Cities and Towns where Premiums were paid.	Amount paid to Parties Outside the State.	Number of Male Members.	Number of Female Members.	Total Membership.	Number of Institutes held.	Average Number attending Institutes.	
-	[4] 689	-	6	$183 50	194	40	234	3	58	1
$778 00	[5] -	[5] -	8	-	262	213	475	3	70	2
-	71	15	9	-	281	289	570	3	89	3
3,250 00	450	15	[6] 18	180 00	601	105	706	3	142	4
300 00	225	-	22	5 64	901	253	1,154	4	166	5
940 00	117	-	21	64 70	276	192	468	3	50	6
-	446	-	28	-	1,166	14	1,180	3	75	7
1,300 00	[4] 250	-	[5] -	-	[6] 1,200	[6] 200	[6] 1,400	3	155	8
600 00	[4] 121	-	11	-	[6] 660	[6] 285	[6] 945	3	98	9
490 00	200	13	24	50 00	755	286	1,041	3	138	10
75 00	145	6	21	65	260	120	380	3	57	11
50 00	400	2	22	-	695	40	735	4	106	12
-	73	53	16	-	409	173	582	2	132	13
[8] 1,280 00	390	-	34	904 50	1,476	49	1,525	3	47	14
655 00	88	267	29	-	525	289	814	3	73	15
-	150	41	5	-	94	82	176	3	28	16
-	172	96	73	389 00	750	97	847	10	59	17
-	-	-	-	-	-	-	-	-	-	18
-	219	12	12	-	1,120	450	1,570	4	262	19
480 00	63	20	6	-	364	218	582	3	158	20
100 00	97	31	1	-	237	369	606	3	7	21
580 00	[5] -	[5] -	12	-	330	281	611	3	143	22
-	75	21	8	-	710	545	1,255	4	58	23
695 00	[4] 154	-	21	-	463	424	887	3	118	24
383 00	162	65	25	2 50	638	812	1,450	3	227	25
-	350	200	24	13 50	465	14	479	3	50	26
2,450 00	258	5	49	832 00	1,677	170	1,847	3	220	27
771 75	282	29	33	247 50	457	288	745	3	193	28
1,590 00	213	2	32	129 50	679	348	1,027	3	109	29
960 00	135	43	23	18 00	797	759	1,556	3	100	30
830 00	161	33	30	28 55	396	65	461	3	88	31
$18,547 75	6,156	969	623	$2,999 54	18,838	7,470	26,308	100	[7] 109	

[5] Not reported.

[6] Estimated.

[7] General average of attendance.

DIRECTORY

OF THE

AGRICULTURAL AND SIMILAR ORGANIZATIONS IN MASSACHUSETTS.

APRIL, 1905.

STATE BOARD OF AGRICULTURE, 1905.

Members ex Officio.

HIS EXCELLENCY WILLIAM L. DOUGLAS.
HIS HONOR CURTIS GUILD, JR.
HON. WM. M. OLIN, *Secretary of the Commonwealth.*
H. H. GOODELL,* M.A., LL.D., *President Massachusetts Agricultural College.*
C. A. GOESSMANN, PH.D., LL.D., *Chemist of the Board.*
AUSTIN PETERS, M.R.C.V.S., *Chief of the Cattle Bureau.*
ALFRED AKERMAN, M.F., *State Forester.*
J. LEWIS ELLSWORTH, *Secretary of the Board.*

Members appointed by the Governor and Council.

	Term expires
FRANCIS H. APPLETON of Peabody,	1906
WARREN C. JEWETT of Worcester,	1907
WILLIAM R. SESSIONS of Springfield,	1908

Members chosen by the Incorporated Societies.

Amesbury and Salisbury (Agr'l and Hort'l),	J. J. MASON of Amesbury,	1906
Barnstable County,	JOHN BURSLEY of West Barnstable,	1907
Blackstone Valley,	SAMUEL B. TAFT of Uxbridge,	1906
Bristol County,	WILLIAM A. LANE of Norton (P. O. Barrowsville),	1908
Deerfield Valley,	E. P. WILLIAMS of Ashfield,	1908
Eastern Hampden,	O. E. BRADWAY of Monson,	1906
Essex,	JOHN M. DANFORTH of Lynnfield (P. O. Lynnfield Centre),	1908
Franklin County,	JOHN S. ANDERSON of Shelburne,	1907
Hampshire,	HENRY E. PAIGE of Amherst,	1907
Hampshire, Franklin and Hampden,	J. F. BURT of Easthampton,	1906
Highland,	HENRY S. PEASE of Middlefield,	1908
Hillside,	RALPH M. PORTER of Cummington,	1908
Hingham (Agr'l and Hort'l),	EDMUND HERSEY of Hingham,	1906
Housatonic,	CHARLES H. SHAYLOR of Lee,	1906
Marshfield (Agr'l and Hort'l),	HENRY A. TURNER of Norwell,	1906
Martha's Vineyard,	JOHNSON WHITING of West Tisbury,	1907
Massachusetts Horticultural,	WM. H. SPOONER of Jamaica Plain,	1906
Massachusetts Society for Promoting Agriculture,	N. I. BOWDITCH of Framingham,	1906
Middlesex North,	H. S. PERHAM of Chelmsford,	1907
Middlesex South,	ISAAC DAMON of Wayland (P. O. Cochituate),	1908
Nantucket,	H. G. WORTH of Nantucket,	1906
Oxford,	W. M. WELLINGTON of Oxford,	1907
Plymouth County,	AUGUSTUS PRATT of North Middleborough,	1908
Spencer (Far's and Mech's Assoc'n),	H. H. LEACH of North Brookfield,	1907
Union (Agr'l and Hort'l),	ALBERT H. NYE of Blandford (P. O. Russell),	1907
Weymouth (Agr'l and Ind'l),	QUINCY L. REED of South Weymouth,	1906
Worcester,	WALTER D. ROSS of Worcester,	1908
Worcester East,	W. A. KILBOURN of South Lancaster,	1906
Worcester Northwest (Agr'l and Mech'l),	ALBERT ELLSWORTH of Athol,	1907
Worcester South,	C. D. RICHARDSON of West Brookfield,	1907
Worcester County West,	J. HARDING ALLEN of Barre,	1908

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* Died April 23, 1905.

ORGANIZATION OF THE BOARD.

OFFICERS.

President, . .	His Excellency WILLIAM L. DOUGLAS, *ex officio.*
1st Vice-President,	WILLIAM R. SESSIONS of Springfield.
2d Vice-President, .	AUGUSTUS PRATT of North Middleborough.
Secretary, . .	J. LEWIS ELLSWORTH of Worcester.

Office, Room 136, State House, Boston.

COMMITTEES.

Executive Committee.

Messrs. W. A. Kilbourn of South Lancaster.
John Bursley of West Barnstable.
Wm. H. Spooner of Boston.
Francis H. Appleton of Peabody.
Augustus Pratt of North Middleborough.
C. D. Richardson of West Brookfield.
Edmund Hersey of Hingham.
Henry S. Perham of Chelmsford.

Committee on Agricultural Societies.

Messrs. W. A. Kilbourn of South Lancaster.
Q. L. Reed of South Weymouth.
O. E. Bradway of Monson.
J. Harding Allen of Barre.
J. F. Burt of Easthampton.

Committee on Domestic Animals and Sanitation.

Messrs. Henry S. Perham of Chelmsford.
Johnson Whiting of West Tisbury.
John S. Anderson of Shelburne.
Wm. A. Lane of Norton.
Henry E. Paige of Amherst.

Committee on Gypsy Moth, Insects and Birds.

Messrs. Augustus Pratt of North Middleborough.
J. M. Danforth of Lynnfield.
W. C. Jewett of Worcester.
H. H. Leach of North Brookfield.
Walter D. Ross of Worcester.

Committee on Dairy Bureau and Agricultural Products.

Messrs. C. D. Richardson of West Brookfield.
J. M. Danforth of Lynnfield.
Henry E. Paige of Amherst.
W. M. Wellington of Oxford.
S. B. Taft of Uxbridge.

Committee on Massachusetts Agricultural College.

Messrs. John Bursley of West Barnstable.
W. C. Jewett of Worcester.
Charles H. Shaylor of Lee.
Isaac Damon of Wayland.
A. H. Nye of Blandford.

Committee on Experiments and Station Work.

Messrs. Wm. H. Spooner of Boston.
N. I. Bowditch of Framingham.
H. A. Turner of Norwell.
Ralph M. Porter of Cummington.
E. P. Williams of Ashfield.

Committee on Forestry, Roads and Roadside Improvements.

Messrs. Francis H. Appleton of Peabody.
H. A. Turner of Norwell.
H. G. Worth of Nantucket.
J. J. Mason of Amesbury.
Henry S. Pease of Middlefield.

Committee on Institutes and Public Meetings.

Messrs. Edmund Hersey of Hingham.
H. H. Goodell* of Amherst.
H. S. Perham of Chelmsford.
Wm. R. Sessions of Springfield.
Albert Ellsworth of Athol.

The secretary is a member, *ex officio*, of each of the above committees.

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* Died April 23, 1905.

DAIRY BUREAU.

Messrs. C. D. RICHARDSON of West Brookfield, 1905; HENRY E. PAIGE of Amherst, 1906; J. M. DANFORTH of Lynnfield, 1907.

Executive Officer, ... J. LEWIS ELLSWORTH.
General Agent, ... P. M. HARWOOD of Barre.

CATTLE BUREAU.

AUSTIN PETERS, M.R.C.V.S., *Chief.*

STATE NURSERY INSPECTOR.

HENRY T. FERNALD, PH.D., of Amherst.

SPECIALISTS.

By Election of the Board.

Chemist,	Dr. C. A. GOESSMANN,	Amherst.
Entomologist,	Prof. C. H. FERNALD,	Amherst.
Botanist,	Dr. GEO. E. STONE,	Amherst.
Pomologist,	Prof. F. A. WAUGH,	Amherst.
Veterinarian,	Prof. JAMES B. PAIGE,	Amherst.
Engineer,	WM. WHEELER,	Concord.
Ornithologist,	EDWARD HOWE FORBUSH,	Wareham.

By Appointment of the Secretary.

Librarian, F. H. FOWLER, B.Sc., *First Clerk*.

MASSACHUSETTS AGRICULTURAL COLLEGE.

Location, Amherst, Hampshire County.

BOARD OF TRUSTEES.

	Term expires
WILLIAM H. BOWKER of Boston,	1906
GEORGE H. ELLIS of Newton,	1906
J. HOWE DEMOND of Northampton,	1907
ELMER D. HOWE of Marlborough,	1907
NATHANIEL I. BOWDITCH of Framingham,	1908
WILLIAM WHEELER of Concord,	1908
ARTHUR G. POLLARD of Lowell,	1909
CHARLES A. GLEASON of New Braintree,	1909
JAMES DRAPER of Worcester,	1910
SAMUEL C. DAMON of Lancaster,	1910
MERRITT I. WHEELER of Great Barrington,	1911
CHARLES H. PRESTON of Danvers,	1911
WILLIAM R. SESSIONS of Springfield,	1912
M. FAYETTE DICKINSON of Boston,	1912

MEMBERS EX OFFICIO.

His Excellency Governor WM. L. DOUGLAS,
President of the Corporation.

HENRY H. GOODELL,* M.A., LL.D.,	*President of the College.*
GEORGE H. MARTIN,	*Secretary of the Board of Education.*
J. LEWIS ELLSWORTH,	*Secretary of the Board of Agriculture.*

OFFICERS ELECTED BY THE BOARD OF TRUSTEES.

WM. R. SESSIONS of Springfield,	*Vice-President of the Corporation.*
J. LEWIS ELLSWORTH of Worcester,	*Secretary.*
Prof. GEO. F. MILLS of Amherst,	*Treasurer.*
CHARLES A. GLEASON of New Braintree,	*Auditor.*
WILLIAM P. BROOKS, Ph.D.,	*Acting President of the College.*

BOARD OF OVERSEERS.

The State Board of Agriculture.

EXAMINING COMMITTEE OF THE BOARD OF AGRICULTURE.

Messrs. BURSLEY, JEWETT, SHAYLOR, DAMON and NYE.

HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE.

HENRY H. GOODELL,* M.A., LL.D.,	*Director.*
WILLIAM P. BROOKS, Ph.D.,	*Agriculturist and Acting Director.*
F. A. WAUGH, B.Sc.,	*Horticulturist.*
CHARLES H. FERNALD, Ph.D.,	*Entomologist.*
HENRY T. FERNALD, Ph.D.,	*Assistant Entomologist.*
CHAS. A. GOESSMANN, Ph.D.,	*Chemist* (Fertilizers).
JOSEPH B. LINDSEY, Ph.D.,	*Chemist* (Foods and Feeding).
GEORGE E. STONE, Ph.D.,	*Botanist.*
J. E. OSTRANDER, C.E.,	*Meteorologist.*

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* Died April 23, 1905.

AGRICULTURAL SOCIETIES INCORPORATED BY SPECIAL ACT OF THE LEGISLATURE, AND REPRESENTED ON THE BOARD OF AGRICULTURE.

NAME.	PRESIDENT.	SECRETARY.	TREASURER.
Amesbury and Salisbury,* . .	Dr. Geo. E. Battis, Amesbury.	Edward W. George, Amesbury.	N. E. Collins, Amesbury.
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Blackstone Valley, ...	Samuel B. Taft, Uxbridge.	Dr. M. R. Sharpe, Uxbridge.	Dr. M. R. Sharpe, Uxbridge.
Bristol County, ...	Charles T. Oldfield, Norton.	Jas. P. Dunn, Taunton.	E. C. Holt, Taunton.
Deerfield Valley, ...	W. B. Avery, Charlemont.	S. W. Hawkes, Charlemont.	E. F. Haskins, Charlemont.
Eastern Hampden, ...	O. E. Bradway, Monson.	L. E. Chandler, Palmer.	D. L. Bodfish, Palmer.
Essex, ...	Fred'k A. Russell, Methuen.	J. M. Danforth, Lynnfield.	W. S. Nichols, Salem.
Franklin County, ...	Frank O. Wells, Greenfield.	Henry J. Field, Greenfield.	Henry J. Field, Greenfield.
Hampshire, ...	Dr. Henry E. Paige, Amherst.	S. J. Reed, Amherst.	S. J. Reed, Amherst.
Hampshire, Franklin and Hampden.	Wm. A. Bailey, Northampton.	C. A. Montgomery, Northampton.	C. A. Montgomery, Northampton.
Highland, ...	Henry E. Stanton, Huntington.	J. T. Bryan, Middlefield.	M. J. Smith, Middlefield.
Hillside, ...	W. A. Harlow, Cummington.	C. F. Burr, Worthington.	D. E. Lyman, Cummington.
Hingham,*	U. S. Bates, Hingham.	William H. Thomas, Hingham.	Reuben Sprague, Hingham.
Hoosac Valley,†	William Gove, North Adams.	Joseph P. Reed, North Adams.	M. R. Ford, North Adams.
Housatonic, ...	R. Henry Race, North Egremont.	Fred J. Fuller, Great Barrington.	O. C. Bidwell, Great Barrington.
Marshfield,*	H. A. Oakman, North Marshfield.	I. H. Hatch, North Marshfield.	M. H. Kent, Marshfield.
Martha's Vineyard, ...	B. T. Hillman, Edgartown.	F. A. Look, West Tisbury.	Geo. H. Luce, West Tisbury.
Massachusetts Horticultural, .	Arthur F. Estabrook, Boston.	Wm. P. Rich, Boston.	C. E. Richardson, Brookline.
Massachusetts Society for Promoting Agriculture.	C. S. Sargent, Brookline.	F. H. Appleton, Peabody.	R. M. Saltonstall, Newton.
Middlesex North, ...	Arthur H. Cluer, Lowell.	Andrew Liddell, Lowell.	John A. Weinbeck, Lowell.
Middlesex South, ...	Charles F. Parsons, Framingham.	G. E. Harrington, South Framingham.	A. H. Wood, Framingham.
Nantucket, ...	H. G. Worth, Nantucket.	J. F. Murphey, Nantucket.	Asa C. Jones, Nantucket.
Oxford, ...	L. H. Cudworth, Oxford.	J. E. Darling, Oxford.	J. E. Darling, Oxford.
Plymouth County, ...	Augustus Pratt, North Middleborough.	J. Herbert Leonard, Bridgewater.	J. Herbert Leonard, Bridgewater.

* And horticultural.

† Without representation in 1905.

AGRICULTURAL SOCIETIES, ETC. — *Concluded.*

NAME.	PRESIDENT.	SECRETARY.	TREASURER.
Spencer Farmers' and Mechanics' Association.	E. H. Stoddard, East Brookfield.	H. H. Capen, Spencer.	H. H. Capen, Spencer.
Union,*	C. B. Hayden, Blandford.	E. W. Boise, Blandford.	Geo. O. Willard, Blandford.
Weymouth (Ag'l and Ind.),	H. B. Reed, South Weymouth.	T. L. Tirrell, South Weymouth.	E. J. Pitcher, South Weymouth.
Worcester,	B. W. Potter, Worcester.	Miss M. M. Rich, Worcester.	L. F. Herrick, Worcester.
Worcester East,	John E. Thayer, Lancaster.	Warren Goodale, Clinton.	Lucius Field, Clinton.
Worcester Northwest (Agricultural and Mechanical).	Dr. James Oliver, Athol.	Albert Ellsworth, Athol.	E. L. Worrick, Athol.
Worcester South,	Geo. L. Clemence, Southbridge.	C. V. Corey, Sturbridge.	C. V. Corey, Sturbridge.
Worcester County West,	Geo. H. Ellis, West Newton.	Matthew Walker, Barre.	John L. Smith, Barre.

* And horticultural.

HORTICULTURAL SOCIETIES.

NAME.	LOCATION.	PRESIDENT.	SECRETARY.
Cape Ann,	Gloucester,	Bennett Griffin, Gloucester.	Wm. D. Lufkin, Gloucester.
Haverhill,	Haverhill,	Walter Goodrich, Haverhill.	Mrs. William M. Webster, Haverhill.
Hampden County,	Springfield,	Jacob C. Lutz, Springfield.	William F. Gale, Springfield.
Houghton,	Lynn,	William Stone, Lynn.	Miss Ruth S. Wood, Lynn.
Lenox,	Lenox,	R. A. Schmid, Lenox.	George Foulsham, Lenox.
Massachusetts,	The State,	Arthur F. Estabrook, Boston.	Wm. P. Rich, Boston.
North Shore,	Manchester,	P. R. Sanborn, Manchester.	James Salter, Manchester.
Springfield Amateur,	Springfield,	W. T. Hutchins, Indian Orchard.	Chas. L. Burr, Springfield.
Worcester County,	Worcester,	O. B. Hadwen, Worcester.	Adin A. Hixon, Worcester.

FARMERS' AND MECHANICS' ASSOCIATIONS.

Bolton,	Bolton,	William N. Felton, Bolton.	William M. Brigham, Bolton.
Middlesex and Worcester,	Hudson,	Oliver Sawyer, Hudson.	Josiah S. Welsh, Hudson.
Needham,	Needham,	A. J. Whiting, Wellesley.	Richmond Favor, Natick.
Oakham,	Oakham,	Wm. Parkman, Oakham.	John P. Day, Jr., Oakham.
Princeton,	Princeton,	J. C. F. Mirick, Princeton.	J. E. Merriam, Princeton.
Westminster,	Westminster,	Judson Foster, Westminster.	H. J. Partridge, Westminster.

FARMERS' AND MECHANICS' CLUBS.

Ashburnham,	Ashburnham,	E. J. Forristall, South Ashburnham.	W. E. Jefts, Ashburnham.
Ashby,	Ashby,	W. O. Loveland, Ashby.	W. J. Smith, Ashby.
Belchertown,	Belchertown,	D. F. Shumway, Belchertown.	Geo. H. B. Green, Belchertown.
Groton,	Groton,	Wm. A. Lawrence, Groton.	L. H. Sheedy, Groton.
Holden,	Holden,	Levi H. Howe, Holden.	Mrs. H. J. Jones, Holden.
Pepperell,	Pepperell,	L. Adelbert Boynton, Pepperell.	Frank T. Marston, Pepperell.
Shirley,	Shirley,	H. S. Hazen, Shirley Centre.	M. W. Longley, Shirley Centre.
Shrewsbury,	Shrewsbury,	E. A. Bartlett, Shrewsbury.	F. J. Stone, Shrewsbury.

FARMERS' CLUBS.

NAME.	LOCATION.	PRESIDENT.	SECRETARY.
Boxborough,	Boxborough,	Frank A. Patch, Littleton.	C. T. Wetherbee, West Acton.
Buckland,	Buckland,	E. F. Smith, Buckland.	Mrs. E. F. Smith, Buckland.
Chamberlain District,	Worcester,	Pliny Moore, Worcester.	S. A. Burgess, Worcester.
East Charlemont,	East Charlemont,	W. W. Smith, East Charlemont.	Geo. H. Wheeler, East Charlemont.
Easthampton,	Easthampton,	E. H. Clark, Easthampton.	C. W. Smith, Easthampton.
Franklin,	Franklin,	L. W. Daniels, Franklin.	Fred M. Thayer, Franklin.
Halifax,	Halifax,	Van Buren Grover, Halifax.	Mrs. Geo. W. Hayward, Halifax.
Lancaster,	Lancaster,	George F. Morse, South Lancaster.	F. A. Hanaford, South Lancaster.
New Braintree,	New Braintree,	D. C. Wetherell, New Braintree.	W. W. Merrill, North Brookfield.
Rehoboth,	Rehoboth,	Dr. C. N. Raymond, Rehoboth.	Oscar E. Perry, Rehoboth.
Rowley,	Rowley,	J. D. Dodge, Rowley.	T. P. Hale, Rowley.
Rutland,	Rutland,	George F. Goldthwaite, Rutland.	Mrs. H. J. Davis, Rutland.
South Bristol,	New Bedford,	Franklyn Howland, Acushnet.	Allen Russell, Jr., Acushnet.
Tatnuck,	Worcester,	H. W. Moore, Worcester.	H. R. Kinney, Worcester.
Upton,	Upton,	Geo. H. Stoddard, Upton.	Francis T. Nelson, Upton.
West Brookfield,	West Brookfield,	Dr. Winsor R. Smith, West Brookfield.	Sumner H. Reed, West Brookfield.
West Newbury,	West Newbury,	Lewis Knight, West Newbury.	Parker H. Nason, West Newbury.
Wilbraham,	Wilbraham,	B. F. Green, North Wilbraham.	H. M. Bliss, R. F. D. 2, Ludlow.

POULTRY ASSOCIATIONS.

Adams Poultry Association,	Adams,	Dr. F. I. Wilder, Adams.	John J. Caley, Adams.
Amesbury Poultry and Pet Stock Association.	Amesbury,	W. E. Tibbets, Amesbury.	M. H. Sands, Amesbury.
Athol Poultry and Pet Stock Association,	Athol,	- -	J. E. Burt, Athol.
Brockton Poultry Association,	Brockton,	M. E. Holmes, Campello.	C. A. Brown, Brockton.
Essex County Poultry Association,	Beverly,	E. A. Morrow, Salem.	Daniel P. Foster, North Beverly.
Falmouth Poultry Association,	Falmouth,	E. P. Davis, Falmouth.	R. E. Small, Falmouth.
Fitchburg Poultry and Pet Stock Association.	Fitchburg,	Frank A. Wood, Fitchburg.	J. Lee Frost, Fitchburg.
Greenfield Score Card Poultry Club,	Greenfield,	Theodore C. Forbes, Greenfield.	B. Buffum Noyes, Greenfield.
Lawrence Poultry and Pet Stock Association.	Lawrence,	B. D. Todd, Lawrence.	Asa L. Harris, Lawrence.
Lynn Poultry Association,	Lynn,	J. Fred Bessom, Lynn.	Chas. E. Hunt, Lynn.
Milford Poultry Association,	Milford,	J. E. Nolan, Milford.	W. H. Pyne, Milford.
New Bedford Poultry Association,	New Bedford,	Jas. B. Hamlin, Acushnet.	Norman Barstow, New Bedford.
North Abington Poultry Association,	North Abington,	Chas. W. Pratt, North Abington.	Jas. H. Dwyer, North Abington.
Northampton Poultry Association,	Northampton,	C. E. Hodgkins, Northampton.	J. A. Zaframboise, Northampton.
Plymouth Poultry Association,	Plymouth,	T. Allen Bagnell, Plymouth.	F. C. Chandler, Kingston.
Springfield Poultry and Pet Stock Association.	Springfield,	E. L. Smith, West Springfield.	E. S. Evans, Springfield.
West Brookfield Poultry Association,	West Brookfield,	R. H. Buffington, West Brookfield.	E. L. Richardson, West Brookfield.

MISCELLANEOUS.

NAME.	LOCATION.	PRESIDENT.	SECRETARY.
Bay State Agricultural Society,	The State,	C. Minot Weld, Boston.	N. I. Bowditch, Framingham.
Boston Market Gardeners' Association,	Boston and vicinity,	W. W. Rawson, Arlington.	J. B. Shurtleff, Jr., Revere.
Brockton Agricultural Society,	Brockton,	Hon. H. W. Robinson, Brockton.	Baalis Sanford, Brockton.
Cranberry Growers' Association,	Cape Cod District,	Emulous Small, Harwichport.	Franklin Crocker, Hyannis.
Franklin Harvest Club,	Connecticut Valley,	H. A. Wells, Deerfield.	C. B. Lyman, Southampton.
Hampden Agricultural Society,	Springfield,	C. W. Bemis, Longmeadow.	E. S. Batchelder, Springfield.
Hampden Harvest Club,	Connecticut Valley,	The members alternately.	C. A. Judd, South Hadley Falls.
Massachusetts Cattle Owners' Association,	The State,	S. C. Dresser, Westborough.	J. L. Harrington, Lunenburg.
Massachusetts Creamery Association,	The State,	W. H. Wright, Easthampton.	A. M. Lyman, Montague.
Massachusetts Forestry Association,	The State,	Dr. Henry P. Walcott, Cambridge.	Edwin A. Start, Boston.
Massachusetts Fruit Growers' Association,	The State,	A. G. Sharp, Richmond.	S. T. Maynard, Northborough.
Wakefield-Reading Fair Company,	Wakefield,	George A. Shackford, Reading.	B. F. Calley, Jr., Wakefield.
Ware Agricultural Society,	Ware,	F. F. Gilmore, Ware.	E. P. Lovett, Ware.
Westborough Agricultural Society,	Westborough,	G. H. Rogers, Westborough.	F. P. Rogers, Westborough.
Worcester County Harvest Club,	Worcester,	B. W. Potter, Worcester.	Mrs. W. C. Jewett, Worcester.
Worcester County Bee-keepers' Association,	Worcester,	F. H. Drake, East Brookfield.	C. R. Russell, Worcester.
Worcester North Agricultural Society,	Fitchburg,	H. O. Mead, Lunenburg.	W. H. Laws, Ashburnham.

MASSACHUSETTS PATRONS OF HUSBANDRY.

OFFICERS OF THE STATE GRANGE, 1905.

Master,	George S. Ladd of Sturbridge.
Overseer,	Carlton D. Richardson of West Brookfield.
Steward,	John E. Gifford of Sutton.
Assistant Steward,	Herbert Sabin of Amherst.
Lecturer,	Charles H. Rice of Leominster.
Chaplain,	Rev. A. H. Wheelock of Pepperell.
Treasurer,	Hon. F. A. Harrington of Worcester.
Secretary,	Wm. N. Howard of South Easton.
Gate Keeper,	I. H. Lamb of Stoughton.
Ceres,	Mrs. Mary E. Jewett of Worcester.
Pomona,	Miss Mary E. Cutler of Holliston.
Flora,	Mrs. Ethel C. Plumb of Stafford, Conn.
Lady Assistant Steward,	Mrs. S. Mabel Thompson of Hopkinton.

EXECUTIVE COMMITTEE.

Elmer D. Howe,	Marlborough.
C. A. Dennen,	Pepperell.
George L. Clemence,	Southbridge.

GENERAL DEPUTY.

C. D. Richardson,	West Brookfield.

POMONA DEPUTIES.

Hon. M. A. Morse,	Belchertown.
Mrs. S. Ella Southland,	Athol.
Dr. James Oliver,	Athol Centre.

SUBORDINATE GRANGE DEPUTIES.

Marcellus Boynton,	Assonet.
E. E. Chapman,	Ludlow.
George E. Crosby,	Lowell, R. F. D. No. 1.
C. C. Colby,	Hubbardston.
F. H. Stevens,	West Acton.
C. A. Stimson,	Royalston.
E. A. Emerson,	Haverhill.
C. M. Gardner,	Westfield.
George W. Sherman,	Brimfield.
L. R. Smith,	Hadley.
C. O. Littlefield,	Sherborn.
E. H. Gilbert,	North Easton, R. F. D.
W. D. Seaver,	Station A, Gardner.
L. H. Cudworth,	Oxford.
W. H. Sawyer,	Winchendon.
W. A. Harlow,	Cummington.
F. L. Warfield,	Buckland.
C. E. Robinson,	Hinsdale.

SPECIAL DEPUTIES.

William N. Howard,	South Easton.
Herbert Sabin,	Amherst.
F. H. Plumb,	Stafford, Conn.
W. T. Herrick,	Westborough.

MASSACHUSETTS PATRONS OF HUSBANDRY — *Continued.*

NAME.	MASTER.	LECTURER.	SECRETARY.
Pomona Granges.			
Middlesex and Norfolk, No. 1,	Nathan W. Fisher, Walpole.	Charles O. Littlefield, Sherborn.	Mrs. Nellie S. Stevens, Wellesley, R. F. D.
Essex County, No. 2,	Ira J. Webster, Haverhill.	Mrs. Elizabeth M. Newell, West Newbury.	Miss Matilda B. Lund, West Boxford.
Middlesex-Worcester, No. 3,	Frank T. Marston, East Pepperell.	D. W. Mason, Ayer.	Mrs. Minnie L. Knight, Townsend Harbor.
Franklin and Worcester, No. 4,	L. G. Barrett, Orange.	Mrs. S. Ella Southland, Station A, Athol.	Luther E. Stewart, Athol, R. F. D.
Worcester West, No. 5,	W. H. Sawyer, Winchendon.	Mrs. Lizzie J. Patterson, Barre.	Mrs. Eva S. Moore, Hubbardston.
Berkshire County, No. 6,	Robert P. Coleman, Pittsfield, R. F. D.	W. B. Barton, Dalton.	Mrs. Nina P. Morse, Dalton.
Worcester Central, No. 7,	Fred Midgley, Worcester.	Mrs. E. H. Harrington, North Grafton.	Mrs. Ellen M. Hayward, Millbury.
Hampshire County, No. 8,	Charles R. Damon, Williamsburg.	R. W. Lyman, Northampton.	Mrs. M. A. Ward, South Deerfield.
Worcester Southwest, No. 9,	E. T. Torrey, Southbridge.	Mrs. Mary Olds Lakin, Brookfield, R. F. D.	Mrs. Mary Q. Ainsworth, East Brookfield, R. F. D.
Worcester and Norfolk, No. 10,	Wm. P. Greenwood, Milford.	Mrs. Ada M. Stearnes, East Blackstone.	Albert W. Gaskill, Mendon.
Borough Pomona, No. 11,	George R. Osgood, Hudson.	Mrs. S. Mabel Thompson, Westborough, R. F. D.	Mrs. Maria Gilmore, Westborough, R. F. D.
Springfield, No. 12,	F. A. Forward, Granby.	C. B. Bennett, Ludlow.	Mrs. C. L. Hayward, Agawam.
Old Colony, No. 13,	Walter T. Packard, Campello.	Mrs. S. V. Carpenter, Attleborough.	Mrs. Alida N. Stevens, South Braintree.
Worcester East, No. 14,	O. W. Haynes, Bolton.	Rev. E. C. Headle, Bolton, R. F. D.	Mrs. E. T. Cunningham, Lancaster.
Quaboag, No. 15,	J. P. Ranger, North Brookfield.	A. C. Stoddard, North Brookfield.	Miss Carrie A. Smith, West Brookfield.
Middlesex North, No. 16,	Norman L. Peavey, Pawtucketville, Lowell.	George P. Greenwood, Billerica.	Mrs. Mabel H. Peavey, Pawtucketville, Lowell.
Deerfield Valley, No. 17,	A. P. Goldthwait, Rowe.	Mrs. D. P. Bardwell, Bardwell's Ferry.	Miss Mary Burrington, Heath.
Western Hampden, No. 18,	H. R. Gooch, Huntington.	C. A. Williams, Montgomery.	Miss Annette Sackett, Westfield.
Connecticut Valley, No. 19,	Edwin B. Hale, Bernardston.	Mrs. E. A. Hawkes, Deerfield.	Mrs. Henry B. Barton, Riverside.
Hillside, No. 20,	W. A. Harlow, Cummington.	Albert Howes, Ashfield.	Horace Cole, Worthington.

Subordinate Granges.			
"Guiding Star" of Greenfield, No. 1.	Haven A. Mowry, Greenfield.	John W. Bragg, Greenfield.	George A. Graves, Greenfield.
Deerfield, No. 2,	H. A. Wells, Deerfield.	Miss Nellie Birks, Deerfield.	P. G. Davis, Deerfield.
Northfield, No. 3,	H. H. Mason, Northfield.	Mrs. M. T. Moore, Northfield.	Mrs. T. R. Callender, Northfield.
Groton, No. 7,	A. T. Sargent, Groton.	Mrs. Mary E. Boynton, Groton.	Mrs. E. P. Woolley, Groton.
Conway, No. 8,	Joseph Antes, Conway.	A. J. Patterson, Conway.	Miss Anna Hopkins, Conway.
Barre, No. 9,	E. E. Rice, Barre.	Rev. Charles H. Smith, Barre.	George N. Harwood, Barre.
"Hope" of Hadley, No. 15,	Leslie R. Smith, Hadley.	A. L. Carpenter, Hadley.	Mrs. Henry Edson Smith, Hadley.
Amherst, No. 16,	Andrew Lydell, Amherst.	Mrs. Cora Crafts, Amherst.	Mrs. T. E. Brigham, Amherst.
Cheshire, No. 17,	Henry N. Jenks, Adams.	Mrs. Maude L. Purdy, Cheshire.	Jabez C. Jenks, Adams.
Hinsdale, No. 19,	F. F. Watkins, Hinsdale.	T. F. Barker, Hinsdale.	Miss Ruby C. Watkins, Hinsdale.
Westfield, No. 20,	Simon Hart, Westfield.	D. M. Cole, Westfield.	Miss Annette Sackett, Westfield.
Lanesborough, No. 21,	N. N. Cummings, Lanesborough.	Miss Eunice Tillottson, Lanesborough.	Mrs. S. L. Miner, Lanesborough.
Worcester, No. 22,	Charles A. Harrington, Worcester.	Mrs. George E. Bowen, Worcester.	Mrs. C. W. Moore, Worcester.
Dalton, No. 23,	F. N. Groesbeck, Dalton.	James Bardin, Dalton.	W. H. Woodworth, Dalton.
Blandford, No. 24,	Clarence W. Bates, Blandford.	George M. Emmons, Russell.	Miss Bertha M. Richards, Blandford.
New Lenox, No. 26,	Harvey H. Dewey, New Lenox.	Chauncey H. Sears, New Lenox.	Miss Maida A. Sears, New Lenox.
Easthampton, No. 27,	Miss Myrtie Ward, Easthampton.	Mrs. George T. Porter, Easthampton.	Mrs. Anna Dibble, Easthampton.
Richmond, No. 32,	W. O. Wheeler, Richmond, R. F. D.	Mrs. Jessie H. Fairfield, Richmond.	Mrs. Ida Coleman, Pittsfield, R. F. D.
Adams, No. 34,	Larkin E. Dudley, Adams.	Mrs. Della Gould, Adams.	Miss Lucy Burt, Adams.
East Granville, No. 40,	Howard B. Dickinson, Granville.	R. G. Hires, Granville.	Mrs. B. F. Gibbons, Granville.
Montgomery, No. 45,	Andrew J. Hall, Montgomery.	Myron E. Kelso, Montgomery.	Miss Florence Moore, Montgomery.
Southwick, No. 46,	Frank D. Lambson, Southwick.	Mrs. C. G. Stone, Southwick.	Nelson J. Trench, Southwick.
Becket, No. 47,	C. M. Capen, Becket.	L. E. Stone, Becket.	J. B. Colt, Becket.
"Highland" of Huntington, No. 48.	Edwin F. Goodwin, Huntington.	Wilbert T. Moore, Huntington.	Hartley R. Gooch, Huntington.
"Granite" of South Worthington, No. 49.	Reuben Drake, Ringville.	Mrs. Mabel Smith, Ringville.	Mrs. Emma Thrasher, South Worthington.
Sterling, No. 53,	James W. Patten, Sterling.	Fred R. Trask, Pratt's Junction.	Louis A. Stuart, Pratt's Junction.
Springfield, No. 54,	George N. Merrill, Springfield.	Mrs. Laura Cummings, Springfield.	Mrs. Lillian C. Cornell, Springfield.
Cummington, No. 56,	Edward B. Streeter, Cummington.	Mrs. Ward A. Harlow, Cummington.	W. E. Ford, Cummington.
Auburn, No. 60,	William E. Barrows, Auburn.	Mrs. C. H. Freeman, Auburn.	Mrs. E. W. Barrows, Auburn.

MASSACHUSETTS PATRONS OF HUSBANDRY — *Continued.*

NAME.	MASTER.	LECTURER.	SECRETARY.
"Union" of Belchertown, No. 64,	F. L. Stebbins, Belchertown.	Mrs. M. G. Ward, Belchertown.	Miss Ella A. Stebbins, Belchertown.
Brimfield, No. 65,	Dr. R. V. Sawin, Brimfield.	Cheney F. Newton, Brimfield.	Mrs. G. E. Hitchcock, Brimfield.
Charlemont, No. 66,	D. J. Davenport, Charlemont.	C. A. Hawkes, Charlemont.	T. M. Totman, Charlemont.
Hardwick, No. 67,	W. A. Robinson, Hardwick.	Mrs. W. A. Robinson, Hardwick.	John N. Hillman, Hardwick.
Shelburne, No. 68,	Daniel P. Bardwell, Shelburne.	Mrs. D. P. Bardwell, Shelburne.	George E. Taylor, Jr., Shelburne.
Ashfield, No. 69,	Harlan P. Howes, Spruce Corner.	Morton A. Sturtevant, Ashfield.	Mrs. Maud C. Dyer, Ashfield.
Phillipston, No. 70,	D. W. Baker, Athol, R. F. D. No. 3.	Mrs. Mary H. Chaffin, Phillipston.	Mrs. Cora C. Dunton, Athol, R.F.D. No.3.
Leyden, No. 71,	C. F. Severance, Bernardston.	Mrs. G. H. Denison, Leyden.	Mrs. Gratia E. Campbell, Greenfield.
"Prescott" of Pepperell, No. 73,	Earl M. Stewart, Pepperell.	George A. Mahoney, East Pepperell.	Miss S. Luella Parker, East Pepperell.
Colrain, No. 76,	S. E. Temple, Shattuckville.	Mrs. E. M. Dwight, Griswoldville.	William M. Stacey, Shelburne Falls.
Windsor, No. 77,	Alfred N. Warren, East Windsor.	Mrs. Fannie Ford, Windsor.	Jesse A. Miner, East Windsor.
Holden, No. 78,	F. L. Chamberlain, Station D, Worcester.	Mrs. Clara L. Potter, Holden.	Mrs. C. M. Stanhope, Holden.
Spencer, No. 79,	Joseph Warren, Leicester.	Mrs. C. J. Sibley, Spencer.	J. W. Bigelow, Spencer.
Bernardston, No. 81,	Edwin B. Hale, Bernardston.	Mrs. Emma Hale, Bernardston.	Mrs. Nellie Hale, Bernardston.
"Manhan" of Southampton, No. 82.	Charles S. Hooker, Holyoke.	Jairus L. Frary, Southampton.	Mrs. C. P. Gridley, Southampton.
Warwick, No. 85,	George A. Witherell, Warwick.	Mrs. Etta M. T. Bass, Warwick.	A. J. Hastings, Orange, R. F. D. No. 2.
North Orange, No. 86,	Rollin O. White, North Orange.	Golan A. Miller, North Orange.	Mrs. Martha A. Cheney, North Orange.
Buckland, No. 87,	F. L. Warfield, Buckland.	Mrs. Inez King, Shelburne Falls.	Hezekiah E. Ward, Buckland.
Lee, No. 88,	C. G. Hinckley, Lee.	A. Bradley, Lee.	Mrs. W. M. Shaylor, Lee.
Worthington, No. 90,	Perley A. Skelton, Worthington.	Bessie E. Trow, Worthington.	Mrs. C. K. Bates, Worthington.
Charlton, No. 92,	Henry H. Baker, Charlton.	Mrs. Josephine Balcomb, Dodge, R. F. D.	Mrs. Rosa E. Bowers, Charlton Depot.
Grafton, No. 93,	Edwin E. Howe, Grafton.	Miss Anna C. Gibson, Grafton.	Mrs. Lyman M. Rice, North Grafton.
Petersham, No. 95,	George K. Wilder, Petersham.	Preston R. Crowell, Petersham.	Charles W. Snow, Nichewaug.
Savoy, No. 99,	F. N. Haskins, Savoy.	A. J. McCollock, Savoy.	L. E. Flanders, Savoy.
Shrewsbury, No. 101,	George E. Brigham, Shrewsbury.	Mrs. Fred J. Reed, Shrewsbury.	Fred H. Goddard, Shrewsbury.
Stow, No. 103,	F. H. Stevens, West Acton, R. F. D.	A. H. Gleason, Gleasondale.	Mrs. N. S. Lewis, West Acton, R. F. D.
"Garfield" of No. Dana, No. 104,	Lyman Randall, North Dana.	Elmer A. Collier, North Dana.	James Davenport, North Dana.
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Millbury, No. 107, ...	Fred H. Rice, Box 894, Worcester.	George R. Lincoln, Millbury.	Miss Susan A. Hayward, Millbury.
Hudson, No. 108, ...	W. R. Coolidge, Hudson.	Mrs. Hortense D. Packard, Hudson.	Mrs. Mary E. Lawrence, Hudson.
Sutton, No. 109, ...	Eli K. Vaughan, Sutton.	John E. Gifford, Sutton.	Miss Sarah M. Mills, Sutton.
Sherborn, No. 110, ...	John Reid, Sherborn.	Mrs. May H. Lane, Sherborn.	Miss Annie H. Daniels, South Sherborn.
Boylston, No. 111, ...	Charles Bray, Boylston Centre.	Mrs. Henrietta M. Andrews, Boylston Centre.	Mrs. Angeline B. Bruso, Boylston Centre.
"East Medway" of Millis, No. 112,	Clarence E. Simpson, Millis.	Miss Lillian E. Schaller, Millis.	Miss Jennie A. Gannon, Millis.
Framingham, No. 113, . . .	A. H. Wood, Framingham.	H. B. Walkup, Framingham.	L. M. Marston, Framingham.
Medfield, No. 114, ...	A. H. Clark, Medfield.	Mrs. Emma Damrell, Westwood.	Mrs. W. W. Preston, Medfield.
Holliston, No. 115, ...	C. Melvin Champney, Holliston.	Miss Elizabeth S. Champney, Holliston.	Mrs. Nellie V. Pope, Holliston.
Westborough, No. 116, . . .	W. E. Whitney, Westborough.	W. T. Herrick, Westborough.	Mrs. Julia H. Rogers, Westborough.
Dover, No. 117, ...	E. Fisher Schlusemeyer, Westwood.	Robert C. Douthit, Dover.	J. H. Chickering, Dover.
Southborough, No. 118, . . .	Chas. E. Taylor, Ashland, R. F. D.	Mrs. W. C. Simpson, Southborough.	Waldo A. Fay, Southborough.
Northborough, No. 119, . . .	W. W. Warren, Northborough.	Mrs. Della Corey, Northborough.	Mrs. Mary E. Mentzer, Northborough.
Lancaster, No. 120, ...	J. Fred Brown, South Lancaster.	Miss Annie G. Kilbourn, So. Lancaster.	Miss Mary B. Evans, Clinton.
Sudbury, No. 121, ...	J. Stanley Rice, Maynard, R. F. D.	Mrs. Julia W. Ames, South Sudbury, R. F. D.	Mrs. Ida J. Rice, Maynard, R. F. D.
Templeton, No. 122, . . .	Granville R. Johnson, Templeton.	Mrs. Alice Judd, Templeton.	Mrs. Rachel S. Titterton, Templeton.
Oxford, No. 123, ...	Lester H. Cudworth, Oxford.	Miss Alice M. Brady, Oxford.	Mrs. Mersie F. Howe, Oxford.
Ashland, No. 124, ...	Henry C. Burnham, Ashland.	Mrs. W. A. Stone, Ashland, R. F. D.	Miss Mabel L. Fay, Olive Station, R. F. D.
Upton, No. 125, ...	William H. Wellington, Upton.	Mrs. Elsie S. Wood, Upton.	Mrs. L. Jennie Chapman, West Upton.
Hubbardston, No. 126, . . .	Harry E. Murdock, East Hubbardston.	Darius Parsons, Hubbardston.	Mrs. Mabel Stone, Hubbardston.
Amesbury, No. 127, . . .	Alfred Davis, Amesbury.	Mrs. L. T. Currier, Amesbury.	Charles F. Tibbetts, Amesbury.
North Andover, No. 128, . .	B. W. Farnum, North Andover.	Grace E. Baker, North Andover.	Walter H. Hayes, North Andover.
Gardner, No. 130, ...	Lucius W. French, Station A, Gardner.	Arthur F. Johnson, Gardner.	Miss Mabel B. Cornwell, Gardner.
Boxborough, No. 131, . . .	Ralph E. Whitcomb, West Acton.	Mrs. Louise Woodward, West Acton.	Miss Amy F. Nelson, West Acton.
North Brookfield, No. 132, . .	Leon A. Doane, North Brookfield.	Miss Minnie McCarthy, North Brookfield.	Miss Clara A. Anderson, North Brookfield.
Berlin, No. 134, ...	Lester R. Maynard, South Berlin.	I. Edmund Coulson, South Berlin.	Mrs. L. W. Brewer, Berlin.
Norfolk, No. 135, ...	A. D. Towne, City Mills.	S. E. Fales, Norfolk.	Mrs. Sarah B. Sims, Norfolk.
East Blackstone, No. 137, . .	Justin F. Southwick, Blackstone.	Mrs. Adelaide M. Stearns, Blackstone.	Adrian Scott, Blackstone.
Northampton, No. 138, . . .	A. J. Morse, Northampton.	Mrs. Ida Fuller, Northampton.	Oliver Bradley, Northampton.
East Sandwich, No. 139, . .	John Bursley, West Barnstable.	Harlan P. Holway, Spring Hill.	Elizabeth H. Ware, Spring Hill.

MASSACHUSETTS PATRONS OF HUSBANDRY — *Continued.*

NAME.	MASTER.	LECTURER.	SECRETARY.
West Boxford, No. 140, ...	Frank N. Chadwick, West Boxford.	Henry M. Killam, West Boxford.	Miss Matilda B. Lund, West Boxford.
Montague, No. 141, ...	F. A. Rist, Montague.	Miss Nellie E. Rist, Montague.	Miss Ruby M. Hemenway, North Leverett.
Bolton, No. 142, ...	Miss C. J. Daniels, Bolton, R. F. D.	Mrs. George L. Taylor, Bolton, R. F. D.	Miss Cora L. Mentzer, Bolton, R. F. D.
Mendon, No. 143, ...	Frank H. Wood, Mendon.	James J. Nutter, Mendon.	Freeman C. Lowell, Mendon.
Franklin, No. 144, ...	Mrs. Alice Duprez, Franklin.	Lucius Daniels, Franklin.	Mrs. Mary Taylor, Franklin.
Douglas, No. 145,[1]	S. Putnam Rawson, East Douglas.[1]	Nellie J. Carr, East Douglas.[1]	Sarah E. Brown, East Douglas.[1]
West Newbury, No. 146, . .	John K. Sargent, East Haverhill.	Mrs. Annie E. Jaques, Haverhill.	Herbert N. Carleton, West Newbury.
West Springfield, No. 147, . .	Alexander S. Huth, West Springfield.	Glenn C. Sevey, Springfield.	Miss Edith A. Sykes, West Springfield.
Concord, No. 150, ...	Arthur B. Worthley, Concord.	Mrs. Julia Hosmer, Concord.	Miss Bertha E. Foss, Concord.
Agawam, No. 151, ...	Monroe Hayward, Agawam.	Miss Frances M. Ely, Agawam.	Mrs. Carrie L. Hayward, Agawam.
East Longmeadow, No. 152, . .	Herbert I. Moody, East Longmeadow.	Mollie H. Williams, East Longmeadow.	E. L. Endicott, East Longmeadow.
Wilbraham, No. 153, . . .	Charles C. Beebee, Wilbraham.	Mrs. Fannie R. Pease, Ludlow, R. F. D. No. 2.	Mrs. Luthera E. Bosworth, Ludlow, R. F. D. No. 2.
Haverhill, No. 154, ...	Fred E. Hall, Ayer's Village, Haverhill.	Mrs. G. Howard Smith, Haverhill.	Mrs. Grace A. Merrill, Ayer's Village, Haverhill.
Methuen, No. 155, ...	Wilbur S. Ayer, Methuen.	Arthur L. Scollay, Methuen.	Mrs. Blanche A. Blodgett, Methuen.
West Bridgewater, No. 156, . .	George F. Logue, Cochesett.	L. A. Tower, Westdale.	Rhoda F. Wilbur, West Bridgewater.
Granby, No. 157, ...	Frank M. Graves, Granby.	George A. Fuller, Granby.	Miss Carrie L. Dickinson, Granby.
"Nemasket" of Middleborough, No. 158.	I. B. Thomas, Middleborough, R. F. D. No. 1.	Mrs. L. E. Sampson, Middleborough.	Mrs. Annie D. Deane, Middleborough.
South Hadley, No. 160, . . .	A. L. Wright, South Hadley.	Miss Gertrude E. Brainerd, South Hadley Falls.	Robert S. Childs, Holyoke.
"Laurel" of West Newbury, No. 161.	Charles F. Brown, West Newbury.	James Knight, Newburyport.	Preston C. Rogers, West Newbury, R. F. D.
Dartmouth, No. 162, ...	J. F. Briggs, Dartmouth.	Susie E. Haskell, Dartmouth.	Marcus M. Allen, Dartmouth.
Dudley, No. 163, ...	Dyer S. Elliot, Dudley.	Miss Alice M. Arnold, Dudley.	Miss Ruth D. Vinton, Dudley.
Ware, No. 164, ...	Charles W. Howard, Ware, R. F. D.	Mrs. Mary L. Pierce, Ware.	Frank W. Harwood, Ware.
Hampden, No. 165, ...	Mrs. George T. Ballard, Hampden.	Mrs. Charles Burleigh, Hampden.	James W. Mahoney, Hampden.

Wellesley, No. 166,	Mrs. Nellie S. Stevens, Wellesley, R. F. D.	John F. Mills, Wellesley.	Mrs. Milton A. Parker, Wellesley.
Rowe, No. 167,	Wayne D. Wood, Rowe.	Miss Mary A. White, Rowe.	Mrs. Pearl A. Wordem, Rowe.
Somerset, No. 168,	Chester B. Hathaway, Pottersville.	Eva J. Hathaway, Pottersville.	Miss Lois A. Davis, Pottersville.
Lunenburg, No. 169,	Edwin S. Marshall, Lunenburg.	Clayton E. Stone, Lunenburg.	James Hildreth, Lunenburg.
New Braintree, No. 170,	L. B. Sanford, New Braintree.	S. L. Dickinson, New Braintree.	Mrs. Ida M. Havens, New Braintree.
Merrimac, No. 171,	George B. Crofut, Merrimac.	Miss Alice J. Hoyt, Merrimac.	Miss Grace Jackson, Merrimac.
Ashby, No. 172,	William S. Green, Ashby.	Albert I. Hayward, Ashby.	Mrs. Evelyn H. Lawrence, Ashby.
Hopkinton, No. 173,	George H. Loring, Westborough.	Miss Sadie M. Mortimer, Westborough, R. F. D. No. 2.	Miss Anna M. Fryburg, Hopkinton.
Brookfield, No. 174,	Mrs. Mary E. Lakin, Brookfield.	Lawrence Dayly, Brookfield.	Mrs. Gertrude Hill, Brookfield.
Athol, No. 175,	Mrs. S. Ella Southland, Station A, Athol.	Mrs. Flora Greely, Station A, Athol.	Mrs. Sarah L. Smith, Station A, Athol.
"Miller's River" of Orange, No. 176.	George L. Sprague, Orange.	Ernest S. Putnam, Orange.	W. C. Kidder, Orange.
Sturbridge, No. 177,	Henry D. Haynes, Sturbridge.	Mrs. Phila H. Holmes, Fiskdale.	Harry C. Shepherd, Globe Village.
Ludlow, No. 179,	Elbridge J. Streeter, Ludlow.	Miss Mary Clark, Ludlow Centre.	Mrs. L. C. Chapman, Ludlow.
West Brookfield, No. 180,	Alfred C. White, West Brookfield.	Fred L. Woodward, West Brookfield.	Bernie Conway, West Brookfield.
Westport, No. 181,	C. R. Macomber, Westport.	Charles A. Brightman, Westport.	A. T. Potter, Westport.
Southbridge, No. 182,	Ernest E. Corbin, Southbridge.	Mrs. Jennie E. Vinton, Southbridge.	Miss Adella Hare, Southbridge.
Andover, No. 183,	George L. Averill, Andover.	Mrs. F. M. Foster, Andover.	Edward W. Burtt, Andover, R. F. D.
Topsfield, No. 184,	Warren Tilton, Topsfield.	Miss Agnes Ferguson, Topsfield.	Mrs. Hattie E. Watson, Topsfield.
"Milton" of North Attleborough, No. 185.[1]	George F. Dana, Abbot Run, R. I.[1]	H. P. Caldwell, North Attleborough.[1]	Miss Ruth E. Hunt, North Attleborough.[1]
Fitchburg, No. 186,	Henry J. Andrews, Fitchburg.	Mrs. Abbie J. Babbitt, Fitchburg.	Mrs. Herbert L. Hill, Fitchburg.
Warren, No. 189,	Calvin Bliss, Warren.	Mrs. Sarah Elder, Warren.	Mrs. Alice M. Bliss, Warren.
Bellingham, No. 190,	Frank C. Albee, South Milford.	Dr. N. W. Sanborn, Bellingham.	Wm. P. Greenwood, Milford.
Winchendon, No. 192,	Ira Lord, Winchendon.	Miss Ida Beals, Winchendon.	Charles W. Brooks, Winchendon.
Foxborough, No. 193,	O. P. Cook, Mansfield.	Edward S. Forbes, East Foxborough.	Miss Adella O. Drake, Foxborough.
Townsend, No. 194,	Clara C. Flarity, Townsend.	Minnie L. Knight, Townsend Harbor.	G. A. Wilder, Townsend.
Royalston, No. 195,	Myron Stockwell, Royalston.	Mrs. Sadie Root, Royalston.	N. E. Ingerson, Royalston.
Easton, No. 196,	William N. Craig, North Easton.	Harry A. Smith, North Easton.	Emily M. Drew, North Easton.

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[1] No report; 1904 officers.

MASSACHUSETTS PATRONS OF HUSBANDRY — *Concluded.*

NAME.	MASTER.	LECTURER.	SECRETARY.
"Brookville" of Holbrook, No. 197.	S. A. Linnell, Brookville.	Mrs. Cora Shaw, Brockton.	Miss Ada Soule, Brookville.
Leominster, No. 198, . . .	William J. Nutting, North Leominster.	Frank N. Boutelle, North Leominster.	Chester F. Walker, North Leominster.
Stoughton, No. 199, . . .	Lester M. Gay, West Stoughton.	Miss Isabelle T. Perry, Stoughton.	Mrs. Jennie Spaulding, West Stoughton.
Uxbridge, No. 200, ...	H. W. Phœnix, Uxbridge.	S. Lizzie Farnum, Uxbridge.	Mrs. Kate Thom, Uxbridge.
Bridgewater, No. 201, . . .	E. Lincoln Copeland, Bridgewater.	Ernest Leach, Bridgewater.	Lucius C. Wood, Bridgewater.
Ashburnham, No. 202, . . .	Walter H. Laws, Ashburnham.	Mrs. Imogene S. Hunt, Ashburnham.	Mrs. Sadie M. Fosgate, Ashburnham.
Westminster, No. 203, . . .	Fred G. Parcher, Westminster.	Miss Emma Goddard, Westminster.	Mrs. Kate Dutton, Westminster.
Rowley, No. 204, ...	J. Harris Todd, Rowley.	Daniel H. O'Brien, Rowley, R. F. D.	J. A. Marshall, Rowley.
"Webster" of Marshfield, No. 205,	Alpheus H. Walker, Millbrook.	Mrs. Lizzie C. Flavell, Marshfield.	Francis T. Harlow, Marshfield.
Tewksbury, No. 207, . . .	Arthur Blaisdell, Tewksbury.	Mrs. H. W. Foster, Lowell, R. F. D. No. 1.	Miss S. C. Whittemore, Tewksbury Centre.
Westford, No. 208, ...	Frank C. Wright, Westford, R. F. D. No. 1.	E. G. Boynton, Westford, R. F. D. No. 1.	Mrs. Frank C. Wright, Westford, R. F. D. No. 1.
Shawmut, No. 210, ...	James W. Whitaker, Shawmut, New Bedford.	Mrs. Cynthia Merritt, Shawmut, New Bedford.	John L. Snell, Shawmut, New Bedford.
Chicopee, No. 211, ...	Edwin L. Shaw, Chicopee.	William E. Chapin, Chicopee.	Mrs. Cassie E. Degowin, Chicopee.
"Oak Hill" of Attleborough, No. 212.	Granville R. Field, Attleborough, R. F. D. No. 2.	Mrs. Etta Brigham, Attleborough, R. F. D. No. 4.	Mrs. M. P. Smith, Attleborough, R. F. D. No. 4.
Walpole, No. 214, ...	Edmund Grover, East Walpole.	Mrs. Annie R. Stowell, Walpole.	Mrs. Annie E. Gay, Walpole.
Mattapoisett, No. 215, . . .	Elliot R. Snow, Mattapoisett.	Dr. Erving M. Tilden, Mattapoisett.	Mrs. Alice W. Ashley, Mattapoisett.
Dracut, No. 216, ...	Harry M. Fox, Dracut Centre.	Miss Alice B. Colburn, Dracut.	Miss Rose E. Peabody, Dracut.
Mansfield, No. 217, ...	Howard Fisher, Mansfield.	John Collins, Mansfield.	Mrs. Nora Davison, West Mansfield.
Norton, No. 218, ...	Allison J. Cowles, Norton.	Susan M. Barker, Norton.	Laura F. Barker, Norton.
East Princeton, No. 219, . .	William A. Williams, Princeton.	Calvin A. Drury, Princeton.	Alfred O. Tyler, East Princeton.
Sunderland, No. 220, . . .	Chester Warner, Sunderland.	Miss Abbie T. Montague, Sunderland.	Mrs. M. A. Ward, South Deerfield.
"Anawan" of Rehoboth, No. 221,	Herbert W. Medbery, Rehoboth, R. F. D. No. 2.	Mrs. Adelaide F. Medbery, Rehoboth, R. F. D. No. 2.	Miss Lillian C. Eddy, Rehoboth, R. F. D. No. 2.

Tyngsborough, No. 222,	Lucian C. McLoon, Tyngsborough.	Frank J. Bancroft, Tyngsborough.	Miss Annie E. Wood, Pawtucketville, Lowell.
Billerica, No. 223,	Clarence A. Bowman, Billerica.	Mrs. Lulu M. Hutchins, Billerica.	Mrs. Cora Baker, Billerica.
Sheffield, No. 224,	Mrs. Cora B. Hoyt, Sheffield.	Z. H. Cande, Sheffield.	William S. Conway, Sheffield.
Williamsburg, No. 225,	Luther Warner, Florence.	Mrs. R. D. Ames, Williamsburg.	Mrs. C. R. Damon, Williamsburg.
West Medway, No. 226,	Clinton S. Howe, West Medway.	Mrs. H. Louise Gurney, West Medway.	Mrs. Luella F. Moon, West Medway.
Heath, No. 227,	Justus W. Stetson, North Heath.	Mrs. Ethel Stetson, Heath.	Mrs. Mabel Payne, Heath.
Salisbury, No. 228,	Roy L. Eaton, Salisbury.	D. D. Meader, Salisbury.	Annie M. Pike, Salisbury.
Cochituate, No. 229,	Isaac Damon, Cochituate.	Rufus E. Corlew, Cochituate.	Mrs. Gertrude D. Bishop, Cochituate.
Taunton, No. 230,	Edwin L. Lewis, Taunton.	Clifford A. Field, Taunton.	Miss Ella F. Read, Taunton.
"Ponkapoag" of Canton, No. 231.	Joseph W. Farwell, Ponkapoag.	Miss Isabella C. McIntyre, Milton.	Mrs. Nettie F. Farwell, Ponkapoag.
Plainfield, No. 232,	A. R. Tirrell, Plainfield.	Mrs. Eugene Thatcher, Plainfield.	Miss Anna M. King, Plainfield.
Lexington, No. 233,	Clarence H. Cutler, Lexington.	Edward S. Payson, Lexington.	Curtis S. Cutler, Lexington.
Newbury, No. 234,	Elbridge Noyes, Newbury.	Miss Mary A. Rolfe, Newburyport.	Miss Marcia E. Little, Newbury.
Oakham, No. 235,	Walter M. Robinson, Oakham.	Miss Sarah E. Butler, Oakham.	Miss Lilla B. Robinson, Oakham.
"Quascacunquen" of Byfield, No. 236.	William D. Sprague, South Byfield.	Mrs. Caroline Sprague, South Byfield.	Miss Bertha F. Taylor, Rowley, R. F. D.
Bradford, No. 238,	E. M. Nason, Ward Hill.	Miss Mabel D. Barnes, Haverhill.	Miss Sarah B. Barnes, Haverhill.
North Reading, No. 239,	A. C. Stickney, North Reading.	Miss Elizabeth Hayward, North Reading.	Miss Annie B. Hogan, North Reading.
Shelburne Falls, No. 240,	C. L. Severance, Shelburne Falls.	Mrs. J. W. Turton, Shelburne Falls.	E. S. Hunter, Shelburne Falls.
Palmer, No. 241,	Horace W. Stimson, Palmer.	Mrs. W. H. Laird, Palmer.	Miss Helen L. Stimson, Palmer.
Rutland, No. 242,	George H. Miles, Rutland.	Louis M. Hauff, Rutland.	Mrs. Alice M. Wales, Rutland.
Enfield, No. 243,	Charles W. Felton, Enfield.	H. L. Ryther, Enfield.	E. K. Davis, Enfield.
Chelmsford, No. 244,	Fred L. Fletcher, Westford, R. F. D. No. 1.	Mrs. Ethylin M. Parker, South Chelmsford.	Mrs. E. T. Adams, Chelmsford.
Greenwich, No. 245,	S. R. Thrasher, Greenwich.	Mrs. John Lincoln, Greenwich.	Lilla M. Bishop, Greenwich.

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SEVENTEENTH ANNUAL REPORT

OF THE

HATCH EXPERIMENT STATION

OF THE

MASSACHUSETTS AGRICULTURAL COLLEGE.

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HATCH EXPERIMENT STATION

OF THE

MASSACHUSETTS AGRICULTURAL COLLEGE,

AMHERST, MASS.

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The co-operation and assistance of farmers, fruit-growers, horticulturists and all interested, directly or indirectly, in agriculture, are earnestly requested. Communications may be addressed to the "Hatch Experiment Station, Amherst, Mass."

The following bulletins and reports are still in stock, and can be furnished on demand:—

No. 27. Tuberculosis in college herd; tuberculin in diagnosis; bovine rabies; poisoning by nitrate of soda.
No. 33. Glossary of fodder terms.
No. 35. Agricultural value of bone meal.
No. 41. On the use of tuberculin (translated from Dr. Bang).
No. 57. Fertilizer analyses.
No. 64. Analyses of concentrated feed stuffs.

No. 67. Grass thrips; treatment for thrips in greenhouses.
No. 68. Fertilizer analyses.
No. 75. Fertilizer analyses.
No. 76. The imported elm-leaf beetle.
No. 77. Fertilizer analyses.
No. 79. Growing China asters.
No. 81. Fertilizer analyses; treatment of barnyard manure with absorbents; trade values of fertilizing ingredients.
No. 82. Orchard management; cover crops in orchards; pruning of orchards; report on fruits.
No. 83. Fertilizer analyses.
No. 84. Fertilizer analyses.
No. 86. Orchard treatment for the San José scale.
No. 87. Cucumbers under glass.
No. 89. Fertilizer analyses; ash analyses of plants; instructions regarding sampling of materials to be forwarded for analysis.
No. 90. Fertilizer analyses.
No. 91. Injuries to shade trees from electricity.
No. 92. Fertilizer analyses.
No. 93. Concentrated feeds.
No. 95. Fertilizer analyses; notes on barnyard manure; trade values of fertilizing ingredients.
No. 96. Fungicides; insecticides; spraying calendar.
No. 97. A farm wood lot.
No. 98. Inspection of concentrates.
No. 99. Dried molasses beet pulp; the nutrition of horses.
No. 100. Fertilizer analyses; market values of fertilizing ingredients.
No. 101. Inspection of concentrates.
Special bulletin, — The coccid genera Chionaspis and Hemichionaspis.
Technical bulletin, No. 1, — Greenhouse Aleyrodes; strawberry Aleyrodes.
Technical bulletin, No. 2, — The graft union.
Index, 1888–95.
Annual reports for 1897, 1898, 1899, 1900, 1901, 1902, 1903, 1904.

Of the other bulletins, a few copies remain, which can be supplied only to complete sets for libraries.

ANNUAL REPORT

Of George F. Mills, *Treasurer* of the Hatch Experiment Station of Massachusetts Agricultural College,

For the Year ending June 30, 1904.

Cash received from United States Treasurer,		$15,000 00
Cash paid for salaries,	$6,012 05	
for labor,	3,070 03	
for publications,	1,017 89	
for postage and stationery,	297 42	
for freight and express,	116 30	
for heat, light, water and power,	477 95	
for chemical supplies,	25 40	
for seeds, plants and sundry supplies,	408 19	
for fertilizers,	1,331 20	
for feeding stuffs,	401 28	
for library,	31 70	
for tools, implements and machinery,	221 33	
for furniture and fixtures,	509 31	
for scientific apparatus,	318 21	
for live stock,	313 50	
for travelling expenses,	137 02	
for contingent expenses,	10 00	
for building and repairs,	301 22	
		$15,000 00
Cash received from State Treasurer,	$13,000 00	
from fertilizer fees,	4,204 58	
from farm products,	2,714 79	
from miscellaneous sources,	3,606 92	
Balance June 30, 1903,	3,198 56	
		$26,724 85
Cash paid for salaries,	$13,134 20	
for labor,	1,985 23	
Amount carried forward,	$15,119 43	

Amount brought forward,	$15,119 43	
Cash paid for publications,	1,415 18	
for postage and stationery,	551 11	
for freight and express,	161 96	
for heat, light, water and power,	405 88	
for chemical supplies,	450 71	
for seeds, plants and sundry supplies,	321 52	
for fertilizers,	3 70	
for feeding stuffs,	840 60	
for library,	215 80	
for tools, implements and machinery,	100 34	
for furniture and fixtures,	340 15	
for scientific apparatus,	952 56	
for live stock,	375 75	
for travelling expenses,	1,757 08	
for buildings and repairs,	329 53	
Balance,	3,383 55	
		$26,724 85

I, Charles A. Gleason, duly appointed auditor of the corporation, do hereby certify that I have examined the accounts of the Hatch Experiment Station of the Massachusetts Agricultural College for the fiscal year ended June 30, 1904; that I have found the same well kept and classified as above; that the receipts for the year from the Treasurer of the United States are shown to have been $15,000, and the corresponding disbursements $15,000; for all of which proper vouchers are on file and have been by me examined and found correct, thus leaving no balance of the $15,000; and that $3,383.55 are left of the State appropriation and of funds received from miscellaneous sources.

CHARLES A. GLEASON,
Auditor.

AMHERST, Aug. 15, 1904.

REPORT OF THE BOTANIST.

G. E. STONE, N. F. MONAHAN, ASSISTANT.

With the exception of a continual increase in our correspondence, the same routine has been pursued as in previous years. Experiments have been carried on in the greenhouse as usual on problems connected with roses, carnations, tomatoes, melons and violets. There are obscure diseases connected with these crops, which are in need of further study in order to throw more light on some practical methods of controlling or eliminating them.

Work has been continued on the effects of illuminating gas on trees, — a subject which is becoming important to communities. This matter is receiving attention in various States, on account of the not infrequent destruction of avenues of valuable shade trees. Experiments of various kinds pertaining to electricity and plant life in general have also received some attention. There is an increased interest in this subject, more particularly relating to the injurious effects which are too frequently manifested in valuable shade trees coming in contact with live wires. The department has also given considerable attention to the study of soil organisms, but this work at present is merely in a preliminary stage.

CROPS AS RELATED TO WEATHER CONDITIONS.

Every season is distinctly peculiar as regards the prevalence or non-prevalence of specific fungous growths. The early potato blight appeared in most places to do more injury than usual during the early part of the summer. This is true even where crops were sprayed. As far as this season's results are concerned, it would indicate that spraying was not commenced early enough for controlling this blight.

Most potatoes ought to have been sprayed as early as June 12 or 15, in order to check the blight, or, in other words, when they were less than one-third grown. In regard to the mildew and wet rot on the potatoes, the effects were severe in some localities, and much loss was experienced.

The asparagus rust was more pronounced than last season. A stem rot caused much damage to cultivated dandelions, — a trouble which appears to be an unusual one in this State. Cucumber and melon blight have been exceedingly rare the past summer, being the first for about six years when no trouble has been experienced. The downy mildew (*Plasmopara Cubensis*, (B. and C.) Humphrey) of cucumbers and melons, which is believed to work its way north from the south each year, did not meet our attention once during the season. On the other hand, Alternaria and Anthracnose have existed here and there, but did no appreciable harm.

The worst injuries were due to winter-killing. In our last report we alluded briefly to disastrous effects of winter-killing of various shrubs and plants, caused by the unusual prolonged fall of 1902, and the severe and sudden cold occurring in December of that year. The winter of 1903 and 1904 was even more severe than the preceding one in causing injury to plants, and this injury showed itself in a different manner. Last winter was particularly characterized as causing severe injury to native plants, as well as exotic ornamentals. The effect of the extreme cold on plants was, moreover, quite different in the winter preceding, inasmuch as in 1902 and 1903 freezing of the tender wood above ground largely took place, while the effects of last winter's freeze extended both above and below the surface of the ground. The most characteristic feature of the last winter-killing was the injury done to the roots. This was particularly noticeable on apple, pear and plum trees, and the white pine suffered to a considerable extent in some localities. Many ornamental shrubs and vines also show the same characteristic effects of root killing. Numerous apple trees were killed outright, and thousands lost a greater or less number of limbs, due to an inadequate root system to supply them. Pear trees did not seem to be affected so extensively as the apple. We observed pear trees which had their trunks split open two or three inches by the frost. The crevices eventually closed and commenced to heal over in the spring, although the effects of partial root killing have left many of them in a bad condition. The splitting of the stem is what is termed sun scald or frost crack, and the frost and sun are believed to be responsible for it. One of the characteristic results of partial root killing is that the trees will bear leaves in the spring and appear normal for a while, when suddenly the leaves commence to turn yellow and brown, and finally dry up and drop off. If only part of the root system is injured, the effects will show only on one or more branches or limbs; but when a large portion of the root system is involved, the whole tree is likely to collapse. The development of the leaves of many apple trees, and in some instances of peach and plum trees which had partially leaved out, was suddenly arrested, and they remained in this condition all summer.

White pines in some localities appeared to be injured extensively by cold, and such native species as the white ash, red and sugar maples, birches and poplars showed the effects of the severe winter. The red maples exhibited in many cases a scarcity of foliage, especially near the top; and more dead wood than usual was observed in some of the other species noted. The effects of root killing show more conspicuously when the soil moisture becomes reduced, and in many cases not until the season had become quite advanced did some trees show the effects of winter-killing. The effects on exotic plants were more severe than in 1902, since, in addition to the part above ground, the roots were injured.

Japanese maples, Japanese clematis, California privet, deutzia, roses, barberries, viburnums, etc., suffered to a considerable extent, and many were killed outright. This list could be greatly extended, and if complete would far exceed that noted in our last report. Sycamore and Norway maples have suffered from the loss of new wood during the past two years, as shown by the death of terminal branches. Grape vine roots were affected in many cases, and in some instances the maturing fruit wilted and dried up as if affected by the black rot.

On the whole, the season can be characterized as showing an unusual amount of winter-killing; in fact, more than has been seen for many years in this State.

TESTING OF SEED.

This department has frequently been called upon to do more or less of this work for farmers, and in many instances for seedsmen. Practically all seedsmen test their own seed; when, however, there is some doubt as to the germinating capacity, it occasionally becomes necessary to submit the seeds to a third party for results; in such cases the station is called upon to make tests. During the past year 120 samples have been tested for farmers and seedsmen.

THE PRACTICE OF SOIL STERILIZATION.

The application of steam under more or less high pressure to greenhouse soils contaminated with sterile fungi, and the use of hot water for partial sterilization, have been practised for a few years by greenhouse growers. We have had considerable experience with growing crops in sterilized soil, and some greenhouse growers have annually resorted to this method of treatment. It is our purpose to give a résumé of the results obtained from this practice.

Sterilization has been the means of lessening the amount of infection in lettuce houses in plants affected with drop and Rhizoctonia, and also of ridding houses of eel worms. It has also been the means of greatly stimulating the growth of crops; and in this respect it is likely to do as much harm as good, when intelligent supervision is not given to the crop. Some greenhouse men have resorted to sterilization for no other purpose than merely to try it, their houses being free from any infection for which this method of treatment could be recommended; while others have followed the practice of sterilizing for the purpose of modifying the growth and texture of their plants.

Besides the desired effect upon the eradication of drop and Rhizoctonia in lettuce houses, it has been the means of modifying to a large extent the texture of lettuce, and it has been employed as a stimulator. It has also been successful in eradicating troublesome insect pests. Its principal drawbacks, however, in growing lettuce, have been due to its stimulating effects on the plant itself, which, where proper precautions are not taken as regards temperature, etc., result in developing a more tender plant, with a loose and less desirable head. A lettuce plant of this type is more tender because it contains more water, and it is not so desirable for the market. Moreover, such plants are inclined to be susceptible to Botrytis rot, if not properly handled. We learned very early in our experiments that, on account of the stimulating effect brought about by growing plants in sterilized soils, it is necessary to hold the crop back by maintaining lower night temperatures. If a temperature of from 8° to 10° F. lower than is customary at night is maintained, so that the crop may develop no faster than one grown under normal conditions, the result will be a crop possessing firm heads of equal texture and resisting qualities to that grown under normal conditions. We have repeatedly called attention to the necessity of this practice in growing lettuce in sterilized soils, but this advice has not always been followed.

There has been a slight increased tendency for lettuce plants to become more subject to Botrytis rot when grown in either sterilized soil or that treated by hot water, owing to a more accelerated growth, and the production of a head of less firm texture. Botrytis rot is the principal disease that most lettuce crops are troubled with at the present time. However, it is not a very serious one with good growers. There will be observed here and there a plant affected with Botrytis rot in the best of houses; the ideal conditions, however, require that there should be none. As to the loss by Botrytis rot by experienced growers, it is of no practical importance, since the percentage will be represented by a small decimal. Botrytis rot can, nevertheless, be eliminated to a greater extent than it is, if lettuce growers would follow certain precautions more carefully. In growing plants in sterilized soil, Botrytis rot can be reduced by paying attention to proper temperature conditions at night, or, in other words, by holding the crop within legitimate limits. The principal sources of Botrytis infection are inferior prickers or seedlings. All prickers showing the black root should be discarded, as this is the beginning of the Botrytis rot. No prickers showing any injuries to the leaves, roots or cotyledons should be utilized, nor should any dead leaves be allowed to form on the plants or be left on them after transplanting. A strict adherence to the above precautions will greatly reduce Botrytis rot.

Another feature which should be considered in connection with the Botrytis rot, as well as rots in general, is watering. Lettuce growers have developed the tendency to do less watering after the crop is set than formerly. They apply most of the water previous to planting, at the present time. This practice induces the plant to develop a better root system. The surface of the soil becomes dry and remains so, which constitutes a great feature in eliminating Botrytis rot, drop, etc. Were it possible for air and sun to obtain access to a lettuce stem, there would scarcely be known such a thing as lettuce rot, with the present skill developed in handling this crop. Some growers have practised for some time the method of thoroughly wetting the soil before planting, and not applying any water after transplanting; while others water occasionally for only two or three weeks after transplanting. We demonstrated quite early in our work the importance of keeping the surface of the soil dry. Subirrigation methods reduce the rots to a considerable extent; and the method of thoroughly wetting the soil previous to planting, and not supplying any water afterwards, is similar in its effects to subirrigation, besides having the advantage of being a much cheaper method. Top coatings of clean, dry sand and other substances have similar effects in reducing rots.

We believe that a great deal can be accomplished in eliminating Botrytis rot and other diseases if more care be taken in selecting seed of a more uniform size and character. Care should be taken in selecting seed that will produce more hardy plants, and that which will produce plants less subject to infection. There is a chance for experimentation and more careful study here.

In one instance we have heard it implied that lettuce crops grown in sterilized soil were prone to mildew. This may result to some extent when the crop is not properly handled; but mildew is confined to the houses of only a very few commercial growers, and its existence in a house at all can be accounted for otherwise. We introduced the mildew into our house several times, but it always died out, and was never known to live through the summer. On the whole, far better lettuce crops are turned out to-day than five years ago, and there is a decided decrease in the amount of infection, due to the application of improved methods of treatment and culture.

As regards the effects of sterilized soil on the growth of cucumbers, our experiments and those of others have shown favorable results, since cucumbers will stand a considerable amount of forcing without any detriment; and we have none of the drawbacks due to excessive stimulation of the crop, such as we find in lettuce. When cucumbers are grown under single lights of glass, or under favorable conditions as regards light, the stimulating effects due to sterilization act most advantageously; while, on the other hand, where the crop is grown under exceedingly abnormal conditions as regards heat, light and moisture, as it sometimes is, no appreciable results are noticeable, except in so far as the treatment eliminates undesirable pests from the soil. Indeed, no form of stimulation is of any practical value to plants when their conditions of growth are extremely abnormal. Sterilization is especially efficacious in destroying eel worms and preventing timber rot, and also destroys some insect pests which trouble the cucumber. One of the special advantages in growing cucumbers in sterilized soil is connected with the seed and seedling, since germination of the seeds is hastened, the plants are accelerated, and damping-off is prevented. A considerable amount of acceleration is given to the growth of the seedling; and in our experiments, where seeds were sown in sterilized and unsterilized soil, we obtained an increase in the actual germination of the seed equal to 33 per cent. in favor of sterilized soil. The expense of sowing seeds and starting seedlings in sterilized soil would be slight, and the results obtained render this process especially desirable.

The growing of carnations in sterilized soil, according to our limited experiments, shows a slightly beneficial effect on the plant, although others who have had more extensive experience have noted very little difference as the result of this practice. It is especially applicable to carnations in eliminating the wet stem rot caused by the fungus Rhizoctonia. In our opinion, there is little reason to believe that sterilizing would succeed in preventing the dry rot caused by Fusarium. With carnations, soil sterilization possesses some advantage in the cutting bed where cuttings are affected with Rhizoctonia and the damping-off fungus (*Pythium De Baryanum*, Hesse). In our rather extensive use of sterilized soil we have never observed any detrimental influence on the soil itself; we have, however, always made use of a tolerably rich soil, well supplied with organic matter.

The principal forms of appliances now used for this purpose are similar, with some modifications, to those which have been employed for five or six years. Perforated iron pipes made up into frames, 10 to 12 feet long and 8 to 10 feet wide, are most generally used. The harrow form of apparatus, known as the Sargent sterilizer, is also largely used, and consists of an iron frame, 4 or 5 by 8 or 10 feet, provided with perforated teeth about 10 or 12 inches apart and 1 foot long. The teeth are thrust into the soil, and the steam is turned on. With this form of apparatus it is not necessary to shovel the soil, hence the process is cheap. The latter type requires a high pressure of steam, and not so great a volume; while the former apparatus requires a large volume of steam, and can be operated to advantage with 15 or 20 pounds of steam pressure.

THE INFLUENCE OF ELECTRICAL POTENTIAL ON THE GROWTH OF PLANTS.[1]

In our last report we gave results of experiments showing the effects of current electricity upon the growth of plants, also the results of subjecting plants and moist seeds to different electrical potentials. We shall give here the results of further experiments along similar lines, and present some results relating to differences of electrical potential which exist between locations in trees and corresponding situations more or less removed from them.

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[1] These experiments were conducted by N. F. Monahan.

In the first series of experiments we will consider the influence of electrical potential upon growth. In subjecting plants to an atmospheric charge of a certain potential we used a glass case such as is described in our preceding report, being, briefly, a glass case 3 feet 4 inches long, 2 feet 9 inches wide and 2 feet 11 inches high, with shellacked wooden frames and bottom. Another case, for comparison, and similar in structure but slightly larger, was also employed. Both cases were tolerably tight when closed, and were placed on movable trucks, from which they were well insulated, in a large greenhouse. The greenhouse screened out, as it were, the atmospheric electricity. At no time have we ever been able to detect any electrical potential in the air in greenhouses. The soil used in growing the plants was of uniform type, very carefully mixed; in fact, every precaution was taken to have the soil conditions the same in each case, and all its various constituents were thoroughly incorporated.

In the case which was to be treated was placed a small water-dripping apparatus, which served as a collector, and which indicated the degree of charging. The air was charged by means of a wire projecting into the case from a Topler-Holtz influence machine. All electrical readings were measured by a Thompson quadrant electrometer.

In the two experiments now described radish plants were employed, as they seemed to be most suitable for the condition under which they were grown. The seeds were of a uniform grade, and were sown in rows 3 inches apart and 1 inch apart in the rows. It was the intention to charge the case each morning to a potential of 150 volts; but this was impossible, as exactly 150 volts could not always be obtained, and at times, on account of the dampness of the air, no charge could be procured from the machine. The doors of both cases were kept closed for four hours after the charge had been induced into the treated case, and at the end of that time they were opened; therefore, for twenty out of every twenty-four hours all the plants were growing under the same conditions. At all times the conditions of temperature and moisture were practically the same in both charged and normal, or uncharged, cases.

TABLE I., EXPERIMENT I. (*Raphanus sativus* L.).—*Showing the Results obtained by electrically charging the Air in a Case.*

CASE.	Average Daily Charge (Volts).	Number of Plants.	TOTAL WEIGHT IN GRAMS OF—	
			Tops.	Roots.
Normal case, ...	-	219	2,211.3	510.3
Electrically charged case, .	167.2	162	2,551.5	623.7

TABLE I., EXPERIMENT I. (*Raphanus sativus* L.).—*Showing the Results obtained by electrically charging the Air in a Case*—Concluded.

CASE.	AVERAGE WEIGHT IN GRAMS OF—		PER CENT. GAINED IN WEIGHT OF—		Total Per Cent. gained.
	Tops.	Roots.	Tops.	Roots.	
Normal case, . . .	10.097	2.333	-	-	-
Electrically charged case,	15.750	3.850	55.98	65.67	57.67

The experiment in Table II. is similar to Experiment I., except that the seeds were planted in rows 5 inches apart, instead of 4, as in the preceding one. The cold weather interfered with the development of the plants, and the experiment was brought to a close earlier than was planned.

TABLE II., EXPERIMENT II. (*Raphanus sativus* L.).—*Showing the Results obtained by electrically charging the Air in a Case.*

CASE.	Average Daily Charge (Volts).	Number of Plants.	TOTAL WEIGHT IN GRAMS OF—	
			Tops.	Roots.
Normal case, ...	-	136	91	98.5
Electrically charged case, .	141.2	69	66	74.0

TABLE II., EXPERIMENT II. (*Raphanus sativus* L.). — *Showing the Results obtained by electrically charging the Air in a Case* — Concluded.

CASE.	AVERAGE WEIGHT IN GRAMS OF —		PER CENT. GAINED IN WEIGHT OF —		Total Per Cent. gained.
	Tops.	Roots.	Tops.	Roots.	
Normal case, . . .	.669	.724	-	-	-
Electrically charged case,	.955	1.072	42.73	49.46	45.58

The results given in tables I. and II. are quite similar. In Table I. there was a gain of 55.98 per cent. in the weight of tops or leaves and 65.67 per cent. in the weight of roots, over the uncharged plants; in Table II., the percentage given for the tops is 42.73 and for the roots 49.46. The total gain in Experiment I. is 57.67 per cent.; in Experiment II. it is 45.58 per cent. The average gain in both experiments was 49.35 per cent. for the tops or leaves, 57.56 per cent. for the roots and 51.62 per cent. as an average total gain for the electrically stimulated plants. The charge in Experiment I. averaged 167.2 volts; in Experiment II., 141.2 volts. The charge only lasted a few seconds in all instances, and practically disappeared from the atmosphere of the case in fifteen minutes.

Some measurements were occasionally made of a dozen typical plants from each case in Experiment I. The object in taking these measurements was, first, to show the difference in size and degree of acceleration, differentiation, etc., of the treated and untreated plants; and, second, to compare the electrically treated plants with those that were not treated, when the latter were practically in the same stage of development; or, in other words, the plants in the electrically charged case were compared with those in the untreated case on the day in which the measurements were made, and also five days later, when the development of the normal plants had reached practically the same stage as that of the plants in the electrically treated case. By this method any changes in the external configuration of the plants brought about by electrical stimulation could be noted.

Table III. shows the results of these measurements, and Table IV. gives a comparison between the leaves of the plants in the charged and uncharged cases, measurements being made August 15 and August 20, respectively.

TABLE III. — *Showing the Average of Some Measurements of Plants in Table I., Experiment I.*

Date.	CASE.	Width of Leaf (Centimeters).	Length of Blade (Centimeters).	Length of Petiole (Centimeters).	Length of Whole Leaf (Centimeters).
August 15,	Normal case, . . .	2.13	4.17	2.28	6.49
	Electrically charged case, .	2.66	5.33	4.34	10.16
	Difference, . . .	.53	1.16	2.06	3.67
August 20,	Normal case, . . .	2.79	4.83	3.35	8.10
	Electrically charged case, .	3.65	6.95	5.20	12.05
	Difference, . . .	.86	2.12	1.85	3.95

TABLE IV. — *Giving a Comparison between the Leaves of the Plants in the Charged and Uncharged Cases.*

Date.	CASE.	Width of Leaf (Centimeters).	Length of Blade (Centimeters).	Length of Petiole (Centimeters).	Length of Whole Leaf (Centimeters).
August 20,	Normal case, . . .	2.79	4.83	3.35	8.10
August 15,	Electrically charged case,	2.66	5.33	4.34	10.16
	Difference, . . .	.13	.50	.99	2.06

The results of these experiments show what was readily discernible with the naked eye; namely, that the length of leaves of the electrically treated plants was quite different from those of the normal or untreated plants, and that the width and length of the leaf blade and the length of the petioles of the plants in the electrically treated case exceeded those of the normal or untreated plants. When comparisons, however, are made of the plants in the electrically treated case of August 15 with those of the normal of August 20, or five days later, it will be observed that the width of the blade of the normal exceeded that of the treated one by .13 centimeters, and that the difference in the length of the blades, petioles and leaves in general was much less marked. The length of the blade, petiole and whole leaf in general was longer for identical periods of development in the electrically treated plants than in the normal or untreated, although the width of the blade was more generally marked in its development in the normal than in the plants in the electrically charged case. The morphological differentiation due to electrical stimulation is shown in these experiments.

The plants in the electrically charged case were of a lighter-green color, and they showed a greater tendency to leaf burn than did the normal plants. They also appeared to be more succulent, but moisture determinations made of the leaves at the close of the experiment showed no difference in this respect. The roots in the treated case were relatively more elongated than those in the untreated case. Whether this form of electrical treatment stimulates plants more than current electricity cannot definitely be determined, from the lack of a sufficient number of comparative results. However, these two experiments would indicate, both from naked-eye observations and from weights and measurements, that static charges act as more pronounced stimuli than current electricity when applied to soils. Electrical stimulation gives rise to effects similar to those caused by lack of light, or such as result from partial etiolation. The light-green color of the foliage and the elongated organs were similar to those noticed in plants grown in poorly lighted greenhouses in winter, and in shaded plants grown in the forest. Other kinds of electrical stimulation appear to have the same general effects on the plant.

Comparison of Atmospheric Electrical Potential in Trees and in the Free Air.

The idea has been advanced that trees, shrubs, and in fact all growing plants, must form a means by which the potential of the air and the earth is held in equilibrium. A living tree does not offer such an enormous resistance to the passage of electricity as dead wood does. We have charged small plants in the laboratory to a sufficiently high potential so that, when placed in the dark, sparks were emitted from many points of the leaves, and living plants will readily take charges from a static machine. It has also been maintained that trees modify the electrical potential of the atmosphere of their immediate surroundings.

Grandeau[1] and other experimenters have shown that when plants are grown under wire netting they develop less in a given space of time than do plants grown under similar conditions in every respect as regards light, etc., in the free atmosphere. The interpretation of this phenomenon is, that wire screens modify the atmospheric electrical potential, or absorb the electricity, as it were, to the detriment of the plant. This method of experimenting with wire nets we have employed only to a limited extent, and at present have not a sufficient number of results on which to report. Unfortunately, most of the experiments previously made in this line are open to severe criticism, from the fact that too few plants were employed, and different methods of surrounding the plants with wire netting prevailed, which accounts for occasional conflicting results. Grandeau obtained similar results by growing plants under a chestnut tree, as under a wire netting; and he concluded that it is probable that trees modify to a large extent the electrical potential of the atmosphere in their immediate neighborhood. The object we had in view in these experiments was to ascertain, among other things, whether trees did modify in any way the electrical potential of the atmosphere in their immediate vicinity. In order to ascertain whether there is any discernible difference between the atmospheric electrical potential in trees and in the free air, at corresponding height and location, we made a series of three readings daily from April to July, and daily readings during the remainder of the experiment, with collectors and a Thompson quadrant électrometer. These observations were started early in the spring, before any foliage had developed, and continued until after the leaves had fallen. A collector was placed in an elm tree, at a height of 40 feet above the ground, at a fork between two limbs from which it was insulated. The collector was situated about on a level with, or slightly above, the spread of the branches and leaves. The tree, however, was not in every respect a typical elm for this region, the head being high and close, with the branches drooping but little.

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[1] "Comptes rendus," T. LXXXVII., 1878, pp. 60, 285, 989. "Chimie et Physiologie appliquées a l'Agriculture et à la Sylviculture par L. Grandeau," Paris, 1879, p. 279.

The collector in the tree is designated as II. in the following monthly records; and the one in the free air, which was located near a building, is designated as I. Collector III. was in a spruce tree, and Nos. IV. and V. were added in August. Collector III. was located 12 feet high, near the top and under the branches of a small Norway spruce. Nos. IV. and V. represent readings from two small Norway spruce trees, about 2 feet high, in pots; they were located about 16 feet from the ground, on a plank scaffold. No. IV. had a copper plate in the soil, which was connected with the electrometer when readings were made. No. V. had a similar plate, but was grounded with an insulated wire; another wire led from this copper plate in the soil to the electrometer.

Readings were taken from the various collectors on the same electrometer at practically the same time each day. Table V. shows readings taken from April 20 to Nov. 1, 1904, and where readings are omitted they could not be obtained. All readings not otherwise recorded imply negative potential.

TABLE V. — *Records showing the Electrical Potential (Volts) taken from an Elm Tree and from Free Air.*

DATE.	9 A.M.		1 P.M.		5 P.M.	
	Collector I. — Free Air.	Collector II. — Elm.	Collector I. — Free Air.	Collector II. — Elm.	Collector I. — Free Air.	Collector II. — Elm.
1904.						
April 21, . .	56.0	56.0	32.0	32.0	0.0	0.0
22, . .	48.0	48.0	32.0	32.0	16.0	16.0
23, . .	8.0	8.0	40.0	40.0	-	-
24, . .	16.0	16.0	16.0	16.0	16.0	-
25, . .	40.0	40.0	40.0	40.0	16.0	16.0
26, . .	32.0	32.0	16.0	16.0	32.0	32.0
27, . .	-	-	60.0	60.0	40.0	40.0
28, . .	8.0	8.0	32.0	32.0	45.0	45.0
29, . .	24.0	0.0	8.0	0.0	0.0	0.0
30, . .	32.0	32.0	-	-	-	-

April 24, trees show signs of budding.

TABLE V. — *Records showing the Electrical Potential (Volts) taken from an Elm Tree and from Free Air* — Continued.

DATE.	9 A.M.		1 P.M.		5 P.M.	
	Collector I. — Free Air.	Collector II. — Elm.	Collector I. — Free Air.	Collector II. — Elm.	Collector I. — Free Air.	Collector II. — Elm.
1904.						
May 1, . .	112.0	112.0	32.0	32.0	0.0	0.0
2, . .	16.0	16.0	12.0	12.0	8.0	8.0
3, . .	48.0	48.0	40.0	40.0	48.0	48.0
4, . .	56.0	56.0	24.0	24.0	24.0	24.0
5, . .	56.0	56.0	56.0	56.0	8.0	0.0
6, . .	12.0	12.0	24.0	24.0	20.0	20.0
7, . .	64.0	64.0	28.0	24.5	-	-
8, . .	-	-	-	-	-	-
9, . .	-	-	-	-	-	-
10, . .	24.0	24.0	28.0	28.0	-	-
11, . .	48.0	48.0	8.0	8.0	16.0	16.0
12, . .	72.0	72.0	80.0	80.0	40.0	40.0
13, . .	64.0	64.0	8.0	0.0	24.0	20.0
14, . .	16.0	14.0	-	-	-	-
15, . .	8.0	0.0	8.0	0.0	-	-
16, . .	-	-	-	-	-	-
17, . .	-	-	32.0	-	-	-
18, . .	-	-	20.0	8.0	20.0	-
19, . .	40.0	32.0	32.0	17.0	16.0	12.0
20, . .	56.0	40.0	32.0	24.0	-	-
21, . .	8.0	0.0	16.0	9.0	20.0	16.0
22, . .	32.0	16.0	-	-	-	-
23, . .	8.0	4.0	16.0	8.0	32.0	24.0
24, . .	16.0	14.0	20.0	12.0	8.0	8.0
25, . .	218.0	32.0	16.0	16.0	20.0	16.0
26, . .	88.0	56.0	32.0	0.0	-	-
27, . .	-	-	-	-	-	-
28, . .	24.0	20.0	24.0	20.0	16.0	0.0
29, . .	32.0	0.0	28.0	0.0	-	-
30, . .	-	-	-	-	-	-
31, . .	-	-	-	-	-	-

May 7, leaves beginning to show; May 9, hardly a trace; May 14, trees fairly well leaved, seeds beginning to drop; heavy thunder showers on 26th; 5 P.M. readings gave extremely high and fluctuating potentials.

TABLE V. — *Records showing the Electrical Potential (Volts) taken from an Elm Tree and from Free Air* — Continued.

DATE.	9 A.M.		1 P.M.		5 P.M.	
	Collector I. — Free Air.	Collector II. — Elm.	Collector I. — Free Air.	Collector II. — Elm.	Collector I. — Free Air.	Collector II. — Elm.
1904.						
June 1, . .	32.0	24.0	16.0	8.0	+8.0	—8.0
2, . .	-	-	-	-	-	-
3, . .	-	-	16.0	8.0	-	-
4, . .	-	-	16.0	8.0	-	-
5, . .	8.0	0.0	8.0	0.0	112.0	56.0
6, . .	20.0	0.0	8.0	0.0	0.0	0.0
7, . .	-	-	-	-	-	-
8, . .	-	-	-	-	-	-
9, . .	-	-	-	-	-	-
10, . .	-	-	16.0	8.0	8.0	0.0
11, . .	28.0	16.0	32.0	20.0	24.0	16.0
12, . .	72.0	56.0	8.0	0.0	8.0	0.0
13, . .	40.0	24.0	40.0	24.0	-	-
14, . .	8.0	0.0	32.0	0.0	-	-
15, . .	16.0	8.0	28.0	24.0	-	-
16, . .	8.0	0.0	8.0	0.0	-	-
17, . .	16.0	8.0	40.0	24.0	-	-
18, . .	36.0	24.0	28.0	20.0	16.0	0.0
19, . .	72.0	48.0	88.0	56.0	8.0	0.0
20, . .	32.0	20.0	16.0	8.0	8.0	0.0
21, . .	20.0	16.0	16.0	8.0	8.0	0.0
22, . .	20.0	8.0	-	-	-	-
23, . .	-	-	-	-	-	-
24, . .	-	-	-	-	-	-
25, . .	-	-	-	-	-	-
26, . .	-	-	-	-	-	-
27, . .	24.0	12.0	8.0	0.0	0.0	0.0
28, . .	16.0	12.0	8.0	trace	8.0	trace
29, . .	-	-	-	-	-	-
30, . .	-	-	-	-	-	-

June 2-4, rain; June 6-9, wet wire.

TABLE V. — *Records showing the Electrical Potential (Volts) taken from an Elm Tree and from Free Air* — Continued.

DATE.	9 A.M.		1 P.M.		5 P.M.	
	Collector I. — Free Air.	Collector II. — Elm.	Collector I. — Free Air.	Collector II. — Elm.	Collector I. — Free Air.	Collector II. — Elm.
1904.						
July 1, . .	-	-	-	-	-	-
2, . .	-	-	-	-	8.0	4.0
3, . .	-	-	-	-	-	-
4, . .	-	-	-	-	-	-
5, . .	36.0	16.0	32.0	20.0	32.0	20.0
6, . .	28.0	12.0	24.0	0.0	24.0	0.0
7, . .	88.0	56.0	8.0	0.0	8.0	0.0
8, . .	-	-	20.0	8.0	28.0	12.0
9, . .	12.0	0.0	48.0	24.0	36.0	20.0
10, . .	-	-	-	-	8.0	0.0
11, . .	24.0	8.0	24.0	0.0	24.0	0.0
12, . .	-	-	-	-	-	-
13, . .	-	-	-	-	-	-
14, . .	-	-	-	-	-	-
15, . .	-	-	-	-	-	-
16, . .	-	-	-	-	-	-
17, . .	-	-	-	-	-	-
18, . .	-	-	-	-	-	-
19, . .	12.0	0.0	8.0	0.0	8.0	trace
20, . .	12.0	trace	16.0	4.0	16.0	4.0
21, . .	16.0	trace	28.0	8.0	12.0	trace
22, . .	-	-	-	-	-	-
23, . .	-	-	-	-	-	-
24, . .	-	-	-	-	-	-
25, . .	-	-	-	-	-	-
26, . .	-	-	-	-	-	-
27, . .	-	-	-	-	-	-
28, . .	20.0	8.0	24.0	8.0	-	-
29, . .	-	-	-	-	-	-
30, . .	28.0	8.0	32.0	16.0	16.0	trace
31, . .	-	-	-	-	-	-

July 12-18, electrometer out of order; July 22-28, rain.

TABLE V. — *Records showing the Electrical Potential (Volts) taken from an Elm Tree and from Free Air* — Continued.

[Collector III., 12 feet high, in Norway spruce. Nos. IV. and V., readings taken from copper plates in soil. Time of observation, 9 A.M.]

DATE.	Collector I. — Free Air.	Collector II. — Elm.	Collector III. — Spruce.	No. IV. — Small Spruce Tree, not grounded.	No. V. — Small Spruce Tree, grounded.
1904.					
August 1, . .	88.0	52.0	-	-	-
2, . .	0.0	0.0	-	-	-
3, . .	8.0	0.0	-	-	-
4, . .	-	-	-	-	-
5, . .	-	-	-	-	-
6, . .	72.0	40.0	-	-	-
7, . .	32.0	16.0	-	-	-
8, . .	96.0	56.0	-	-	-
9, . .	40.0	24.0	-	-	-
10, . .	8.0	0.0	-	-	-
11, . .	16.0	8.0	Very slight movement		
12, . .	56.0	32.0	+4.0	+4.0	+4.0
13, . .	8.0	trace	+trace	+trace	+trace
14, . .	96.0	56.0	+6.0	+8.0	+16.0
15, . .	24.0	16.0	+trace	+4.0	+trace
16, . .	32.0	16.0	trace	+8.0	+12.0
17, . .	0.0	0.0	+8.0	+8.0	+12.0
18, . .	+16.0	+8.0	—8.0	—8.0	—8.0
19, . .	40.0	20.0	0.0	trace	trace
20, . .	-	-	-	-	-
21, . .	72.0	40.0	+8.0	+8.0	+12.0
22, . .	8.0	+trace	+trace	+trace	+trace
23, . .	8.0	trace	+8.0	+4.0	+8.0
24, . .	48.0	24.0	0.0	trace	trace
25, . .	56.0	28.0	0.0	0.0	trace
26, . .	96.0	52.0	+8.0	+8.0	+12.0
27, . .	88.0	40.0	0.0	0.0	0.0
28, . .	40.0	24.0	0.0	0.0	0.0
29, . .	8.0	trace	0.0	0.0	0.0
30, . .	40.0	16.0	+2.0	+2.0	+2.0
31, . .	40.0	24.0	0.0	0.0	0.0

TABLE V. — *Records showing the Electrical Potential (Volts) taken from an Elm Tree and from Free Air* — Continued.

[Collector III., 12 feet high, in Norway spruce. Nos. IV. and V., readings taken from copper plates in soil. Time of observation, 3 P.M.]

DATE.	Collector I. — Free Air.	Collector II. — Elm.	Collector III. — Spruce.	No. IV. — Small Spruce Tree, not grounded.	No. V. — Small Spruce Tree, grounded.
1904.					
August 1, . .	80.0	40.0	-	-	-
2, . .	-	-	-	-	-
3, . .	8.0	0.0	-	-	-
4, . .	-	-	-	-	-
5, . .	-	-	-	-	-
6, . .	24.0	12.0	-	-	-
7, . .	40.0	24.0	-	-	-
8, . .	88.0	56.0	-	-	-
9, . .	24.0	12.0	-	-	-
10, . .	0.0	0.0	-	-	-
11, . .	8.0	0.0	0.0	0.0	0.0
12, . .	40.0	24.0	+4.0	+4.0	+4.0
13, . .	56.0	4.0	+trace	+trace	+trace
14, . .	24.0	12.0	+4.0	+trace	+4.0
15, . .	72.0	40.0	+4.0	+8.0	+12.0
16, . .	16.0	8.0	trace	trace	trace
17, . .	0.0	0.0	0.0	0.0	0.0
18, . .	0.0	0.0	0.0	0.0	0.0
19, . .	40.0	20.0	0.0	0.0	trace
20, . .	-	-	-	-	-
21, . .	40.0	24.0	+4.0	trace	12.0
22, . .	8.0	0.0	0.0	0.0	0.0
23, . .	8.0	0.0	+8.0	trace	trace
24, . .	56.0	32.0	0.0	0.0	0.0
25, . .	32.0	24.0	0.0	0.0	trace
26, . .	72.0	40.0	+8.0	+8.0	+8.0
27, . .	48.0	24.0	0.0	0.0	0.0
28, . .	8.0	trace	0.0	0.0	0.0
29, . .	4.0	0.0	0.0	0.0	0.0
30, . .	16.0	8.0	0.0	0.0	0.0
31, . .	40.0	24.0	0.0	0.0	0.0

TABLE V. — *Records showing the Electrical Potential (Volts) taken from an Elm Tree and from Free Air* — Continued.

[Collector III., 12 feet high, in Norway spruce. Nos. IV. and V., readings taken from copper plates in soil. Time of observation, 9 A.M.]

DATE.	Collector I, — Free Air.	Collector II. — Elm.	Collector III. — Spruce.	No. IV. — Small Spruce Tree, not grounded.	No. V. — Small Spruce Tree, grounded.
1904.					
September 1, .	88.0	52.0	+4.0	+4.0	+4.0
2, .	-	-	-	-	-
3, .	-	-	-	-	-
4, .	96.0	56.0	+8.0	+8.0	+8.0
5, .	72.0	40.0	4.0	2.0	4.0
6, .	—8.0	—trace	+0.0	+0.0	+0.0
7, .	40.0	24.0	0.0	0.0	0.0
8, .	56.0	32.0	0.0	0.0	0.0
9, .	72.0	40.0	0.0	trace	trace
10, .	-	-	-	-	-
11, .	-	-	-	-	-
12, .	-	-	-	-	-
13, .	-	-	-	-	-
14, .	-	-	-	-	-
15, .	-	-	-	-	-
16, .	-	-	-	-	-
17, .	-	-	-	-	-
18, .	-	-	-	-	-
19, .	-	-	-	-	-
20, .	-	-	-	-	-
21, .	-	-	-	-	-
22, .	-	-	-	-	-
23, .	-	-	-	-	-
24, .	-	-	-	-	-
25, .	-	-	-	-	-
26, .	0.0	0.0	0.0	0.0	0.0
27, .	8.0	8.0	0.0	0.0	trace
28, .	-	-	-	-	-
29, .	-	-	-	-	-
30, .	24.0	24.0	0.0	trace	trace

September 6, possibly slight movement toward positive in Nos. III., IV. and V.
Operator away from September 10 to September 25.

TABLE V. — *Records showing the Electrical Potential (Volts) taken from an Elm Tree and from Free Air* — Concluded.

[Collector III., 12 feet high, in Norway spruce. Nos. IV. and V., readings taken from copper plates in soil. Time of observation, 9 A.M.]

DATE.	Collector I. — Free Air.	Collector II. — Elm.	Collector III. — Spruce.	No. IV. — Small Spruce Tree, not grounded.	No. V. — Small Spruce Tree, grounded.
1904.					
October 1, . .	40.0	32.0	4.0	2.0	4.0
2, . .	56.0	48.0	4.0	trace	2.0
3, . .	96.0	80.0	8.0	trace	trace
4, . .	-	-	-	-	-
5, . .	8.0	8.0	4.0	4.0	8.0
6, . .	40.0	36.0	trace	trace	trace
7, . .	-	-	-	-	-
8, . .	-	-	-	-	-
9, . .	-	-	-	-	-
10, . .	-	-	-	-	-
11, . .	-	-	-	-	-
12, . .	-	-	-	-	-
13, . .	-	-	-	-	-
14, . .	8.0	8.0	2.0	2.0	4.0
15, . .	40.0	40.0	4.0	trace	4.0
16, . .	8.0	8.0	trace	0.0	0.0
17, . .	16.0	16.0	2.0	trace	2.0
18, . .	40.0	0.0	0.0	0.0	0.0
19, . .	24.0	24.0	trace	0.0	trace
20, . .	-	-	-	-	-
21, . .	-	-	-	-	-
22, . .	-	-	-	-	-
23, . .	-	-	-	-	-
24, . .	40.0	40.0	0.0	0.0	0.0
25, . .	8.0	8.0	trace	trace	trace
26, . .	-	-	-	-	-
27, . .	-	-	-	-	-
28, . .	-	-	-	-	-
29, . .	8.0	8.0	0.0	trace	trace
30, . .	-	-	-	-	-
31, . .	-	-	-	-	-

October 5, leaves turning color, very few falling; October 20, leaves taken off by high wind; October 24, leaves entirely off trees.

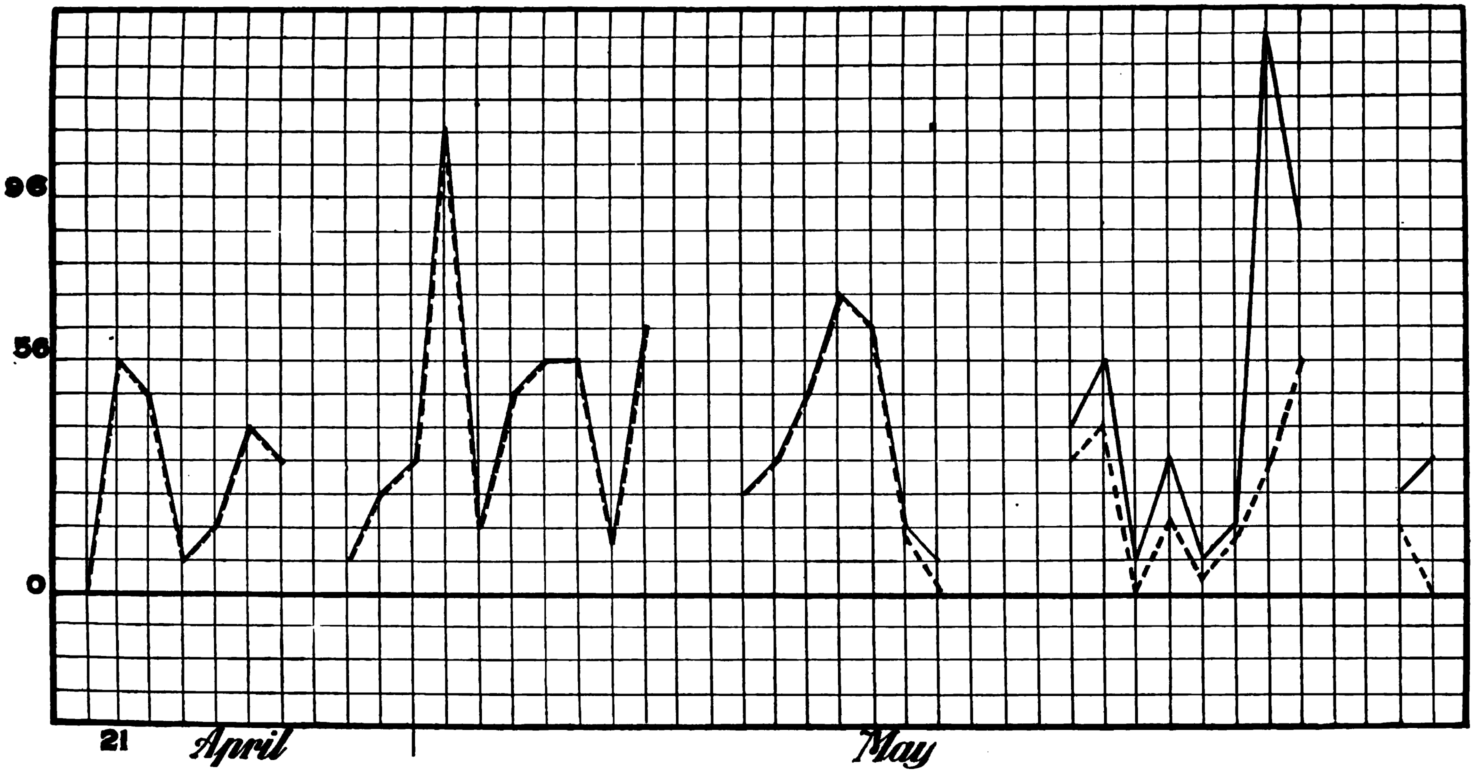

DIAGRAM I. — Showing the results of electrometer readings from free air, Collector I., and elm tree, Collector II., for the months of April and May. The spaces on the abscissa denote days; the spaces on the ordinate denote periods of eight volts each. Solid line indicates free air readings; dotted line indicates elm tree readings.

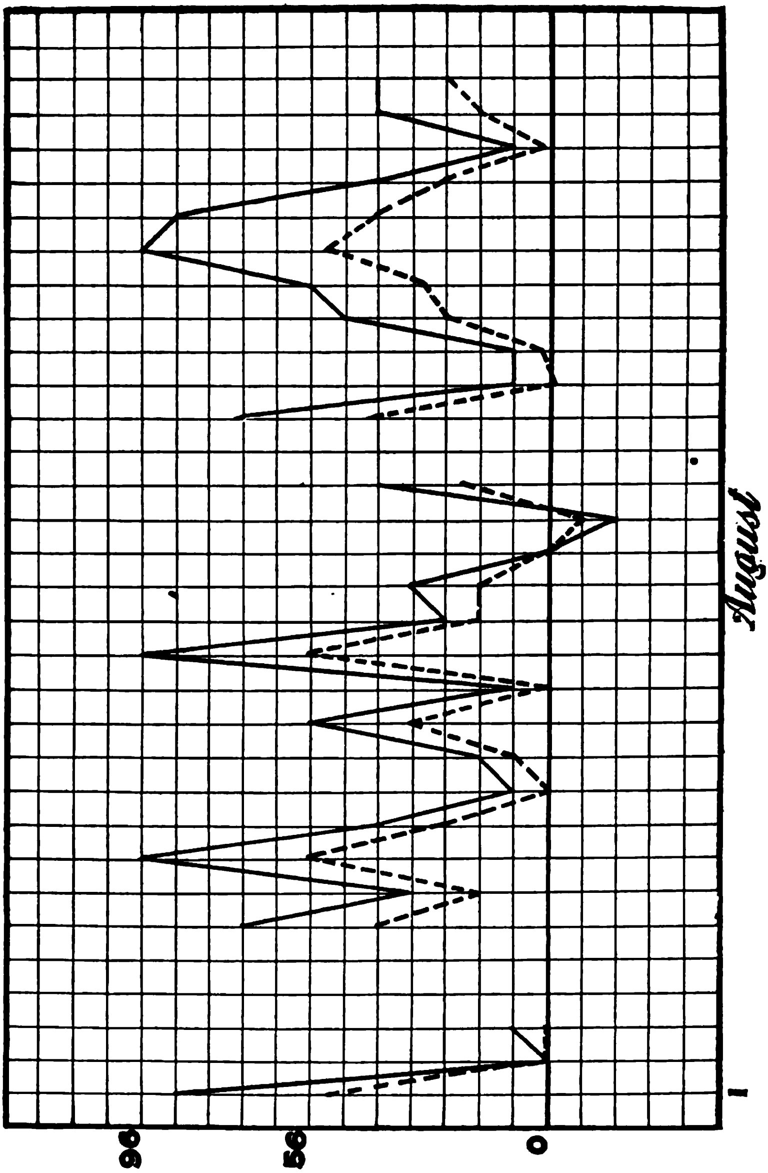

DIAGRAM II.—Showing the results of electrical readings from free air, Collector I., and elm tree, Collector II., for the month of August. The spaces on the abscissa denote days; the spaces on the ordinate denote periods of eight volts each. Solid line indicates free air readings; dotted line indicates elm tree readings.

TABLE VI. — *Summary of Potential Readings of the Preceding Tables, showing the Total and Average Results given by Collector I. (Free Air) and Collector II. (Elm Tree).*

	TOTAL VOLTAGE OF —		AVERAGE DAILY VOLTAGE OF —	
	Collector I. — Free Air.	Collector II. — Elm.	Collector I. — Free Air.	Collector II. — Elm.
April,	240	240	30.0	30.0
May 1 to May 14,	572	572	52.0	52.0
May 14 to May 31,	398	228	44.2	25.3
June,	498	276	38.0	21.2
July,	224	108	37.3	18.0
August,	1,088	592	54.4	29.6
September,	456	276	57.0	34.5
October 1 to October 7,	240	204	48.0	40.8
October 7 to October 31,	152	152	19.0	19.0

While the results obtained from this series of experiments do not possess the same value as the series extending over more than one season, they nevertheless point very strongly to the conclusion that trees do modify to a considerable extent atmospheric electrical potential in their immediate vicinity. By consulting the summary, Table VI., where the total and average potentials for different periods are shown, it will be seen that some important differences occurred between the potentials of the free air and the elm tree collectors. It is significant also that there occurred no difference in the readings between the free air collector and that in the elm tree up to the time when the leaves developed. The few readings which we were able to make in October after the leaves had fallen showed the same results.

Our interpretation of the results of these observations is, that the elm tree took some electricity from the air immediately surrounding it during the period in which it was in foliage. If this single series of observations is typical of what takes place in nature, then we can conclude that the atmospheric electrical potential is not affected much by trees in the immediate vicinity except when they are in foliage. There are a few instances where collectors I. and II. showed positive potentials, and practically the same relative differences are shown here as in the numerous negative potential readings.

The collector in the branches of the spruce tree, 12 feet from the ground (Collector III.), from which it was well insulated, invariably showed the opposite potential from that obtained in the free air and from the elm tree. It will appear from this that the air surrounding the collector in the spruce tree was charged with the same kind of potential (positive or negative) as that of the earth; and the readings taken from Nos. IV. and V., which were very close to this tree, although four feet higher, gave the same kind of potential as that of Collector III., or larger spruce tree. In other words, all the potentials in Nos. III., IV. and V. are opposite to that of the air. There were some difficulties experienced in obtaining readings of the three spruce trees, — partly because the readings had to be taken too close to the ground, and partly, perhaps, because we were dealing with the same kind of potential in the air that the earth was charged with; and that, therefore, when the potential of the air in the branches of the spruce tree and the potential of the earth were the same in degree and kind, differences in potential would not exist, and therefore measurements would be impossible. Evergreen trees, which are supplied with a large number of pointed leaves, may possibly be better adapted to discharge electricity than deciduous trees. It is quite possible that evergreen trees behave quite differently from deciduous trees as regards their relationship to atmospheric electricity. In our opinion, there is a strong probability that all living plants act as conductors, or that they serve to keep the potential of the earth and the air in more or less equilibrium; and that trees and vegetation in general take part in this, although in all probability all species do not act in the same specific manner.

This phase of the subject has not been studied as much as is desirable. We infer from our own observations that some trees show a great tendency towards conducting the electricity from the air to the earth, and that other trees show the same tendency for conducting electricity from the earth to the air; and that in all probability this exchange of electricity from the air to the earth, and *vice versa*, does not take place at the same time through the same tree; and that, under normal conditions, — that is, when no great electrical disturbance is taking place, — some species of trees always conduct the electricity to the air from the earth, while other species conduct electricity from the earth to the air. It is not at all unlikely that in the vicinity of large trees there is exhibited a detrimental influence on crops, and vegetation in general, to an extent which cannot be accounted for by the lack of sunshine and soil moisture.

SOME IMPORTANT LITERATURE RELATING TO DISEASES, ETC., OF CROPS NOT GENERALLY BELIEVED TO BE CAUSED BY FUNGI OR INSECTS.

The publication by Dr. W. C. Sturgis[1] of a host index relating to economic fungi has proved of great value to students, and to those interested in the literature pertaining to fungous diseases of our important cultivated crops. Unfortunately, the host index of Dr. Sturgis does not include those troubles generally termed physiological, or those of an unknown nature.

The following list is compiled to supplement his host index to literature pertaining to fungous diseases. It is by no means complete, but includes at least some of the more important publications of the agricultural experiment stations and United States Department of Agriculture relating to functional and unknown disorders.

APPLE (*Pirus malus*, L.).

Baldwin Fruit-spot, Brown-spot. — N. Y. (Geneva) Agr. Exp. Sta., Bull. No. 164, 1899, pp. 215-219. Vt. Agr. Exp. Sta., Rept. 1899; 1900, pp. 159-164.

Frost-blisters (Leaves). — N. Y. (Geneva) Agr. Exp. Sta., Bull. No. 220, 1902, pp. 217-224. See *Quince*. Mass. Hatch Exp. Sta., Rept. No. 15, 1903, pp. 32-34.

Frost-cracks (Fruit). — Vt. Agr. Exp. Sta., Bull. No. 49, 1895, p. 100. See *Pear*.

Rosette. — Col. Agr. Exp. Sta., Bull. No. 69, 1902, pp. 4-6.

Scald. — Vt. Agr. Exp. Sta., Rept. 1896-97, pp. 55-59; also 11th Rept. 1898, pp. 198, 199.

Spraying and Bloom. — N. Y. (Geneva) Agr. Exp. Sta., Bull. No. 196, 1900.

Spraying Injuries. — N. Y. (Geneva) Agr. Exp. Sta., Bull. No. 220, 1902, pp. 225-230.

APRICOT (*Prunus*).

Leaf-scorch or Sunburn. — Ariz. Agr. Exp. Sta., Rept. 1898, pp. 163-165.

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[1] Conn. (State) Agr. Exp. Sta., Bull. No. 118, 1898; Repts. 17, 1893; 21, 1897; and 24, 1900.

ASTER (*Callistephus hortensis*, Cass.).

Yellows. — Mass. Hatch Exp. Sta., Bull. No. 79, 1902, p. 11.

BEET (*Beta vulgaris*, L.).

Leaf-scorch (*Sugar Beet*). — N. Y. (Geneva) Agr. Exp. Sta., Bull. No. 162, 1899, pp. 167-171.

CAULIFLOWER (*Brassica oleracea*, L.).

Leaf-scorch or Tip-burn. — N. Y. (Geneva) Agr. Exp. Sta., Bull. No. 162, 1899, pp. 176, 177.

CELERY (*Apium graveolens*, L.).

Pithiness. — Maryland Agr. Exp. Sta., Bull. No. 83, 1902; also Bull. No. 93, 1904.

CHERRY (*Prunus Cerasus*, L.).

Leaf-scorch. — N. Y. (Geneva) Agr. Exp. Sta., Bull. No. 162, 1899, pp. 171-176. See *Maple*, etc.

COTTON (*Gossypium*, spp.).

Red Leaf-blight. — Ala. Coll. Sta., Bull. No. 36, 1892, pp. 31, 32.

Shedding of Bolls. — Ala. Coll. Sta., Bull. No. 41, 1892, pp. 50-53.

Yellow Leaf-blight. — Ala. Coll. Sta., Bull. No. 36, 1892, pp. 2-31.

CUCUMBER (*Cucumis sativus*, L.).

Leaf-curl. — Mass. Hatch Exp. Sta., Bull. No. 87, pp. 30, 31.

Stem-curl. — Mass. Hatch Exp. Sta., Bull. No. 87, p. 32.

Wilt. — Mass. Hatch Exp. Sta., Bull. No. 87, p. 32; also Rept. 1899, pp. 159-163.

GRAPE (*Vitis*, spp.).

California Vine Disease. — U. S. Dept. Agr., Div. Veg. Path., Bull. No. 2, 1892. U. S. Dept. Agr., Farmers' Bull. No. 30, pp. 1-11.

Chlorosis. — U. S. Dept. Agr., Div. Veg. Path., Bull. No. 2, 1892, pp. 179-181.

Coulure. — U. S. Dept. Agr., Div. Veg. Path., Farmers' Bull. No. 30, pp. 11-14.

Mal Nero, Rougeot and Folletage. — N. Y. (Cornell Univ.) Agr. Exp. Sta., Bull. No. 76, 1894, pp. 420, 421. U. S. Dept. Agr., Div. Veg. Path., Bull. No. 2, 1892, pp. 181-198.

Sunstroke. — Cal. Agr. Exp. Sta., Rept. 1887-93, pp. 450, 451.

Pourriture. — U. S. Dept. Agr., Div. Veg. Path., Bull. No. 2, 1892, pp. 181, 182.

Shelling. — Conn. (State) Agr. Exp. Sta., Rept. 1896, pp. 278-281. Mich. Agr. Exp. Sta., Bull. No. 121, 1895, p. 51. N. Y. (Cornell Univ.) Agr. Exp. Sta., Bull. No. 76, 1894, pp. 413-440, 452-454.

LETTUCE (*Lactuca sativa*, L.).

Top-burn. — Mass. Hatch Exp. Sta., Bull. No. 69, p. 38; also Rept. 1897, pp. 82-84.

LILY (*Lilium*, spp.).

Bermuda Lily Disease. — U. S. Dept. Agr., Div. Veg. Phys. and Path., Bull. No. 14, 1897.

MELON (*Cucumis Melo*, L.).

Top-burn. — Ga. Agr. Exp. Sta., Bull. No. 57, 1902, p. 190.

ORANGES, LEMONS, ETC. (*Citrus*, spp.).

Blight. — U. S. Dept. Agr., Div. Veg. Phys. and Path., Bull. No. 8, 1896, pp. 9-14. U. S. Dept. Agr., Journ. Mycol., Vol. VII., 1894, pp. 32-34.

Die-back or Exanthema. — Cal. Agr. Exp. Sta., Bull. No. 138, 1902, pp. 40, 41. Fla. Agr. Exp. Sta., Bull. No. 53, 1900, pp. 157-161. U. S. Dept. Agr., Div. Veg. Phys. and Path., Bull. No. 8, 1896, pp. 14-20. U. S. Dept. Agr., Journ. Mycol., Vol. VII., 1894, pp. 29, 30.

Foot-rot or Mal di Gomma. — Fla. Agr. Exp. Sta., Bull. No. 53, 1900, pp. 151-155. U. S. Dept. Agr., Div. Veg. Phys. and Path., Bull. No. 8, 1896, pp. 28-33. U. S. Dept. Agr., Journ. Mycol., Vol. VII., 1894, pp. 30-32.

Melanose. — Fla. Agr. Exp. Sta., Bull. No. 53, 1900, pp. 168, 169. U. S. Dept. Agr., Div. Veg. Phys. and Path., Bull. No. 8, 1896, pp. 33-38.

PEACH (*Prunus Persica*, Benth. and Hook.).

Bordeaux Injury. — Conn. (State) Agr. Exp. Sta., 24th Ann. Rept. 1900, pp. 219-254. N. Y. (Cornell Univ.) Agr. Exp. Sta., Bull. No. 164, 1899, pp. 385-388. See *Plum*. Tenn. Agr. Exp. Sta., Bull., Vol. XV., No. 2, 1902.

Dropsical Swellings of Twigs and Branches. — Ohio Agr. Exp. Sta., Bull. No. 92, 1898, pp. 206-208.

Fruit-crack or Sun-scald. — Col. Agr. Exp. Sta., Bull. No. 41, 1898, pp. 15-18.

Gum Disease. — Mich. Agr. Exp. Sta., Rept. 1896, pp. 123, 124; also Rept. 1897, p. 96. Mich. Agr. Exp. Sta., Bull. No. 156, 1898, p. 304.

Little Peach. — Mich. Agr. Exp. Sta., Rept. 1896. pp. 121, 122; also Bull. No. 156, 1898, pp. 303, 304.

Mechanical Injuries, etc. — Ohio Agr. Exp. Sta., Bull. No. 92, 1898, pp. 189, 190.

Rosette. — Ga. Agr. Exp. Sta., Bull. No. 42, 1898, p. 221. Maryland Agr. Exp. Sta., Bull. No. 42, 1896, pp. 160-162. Oklahoma Agr. Exp. Sta., Bull. No. 20, 1896, p. 21. U. S. Dept. Agr., Div. Veg. Path., Bull. No. 1, 1891. U. S. Dept. Agr., Farmers' Bull. No. 17, pp. 13-17. U. S. Dept. Agr., Journ. Mycol., Vol. VI., pp. 143-148. U. S. Dept. Agr., Journ. Mycol., Vol. VII., 1894, pp. 226-232.

Twig Diseases, — Gum-flow. — Ohio Agr. Exp. Sta., Bull. No. 92, 1898, pp. 199-206.

Twig Spots. — Ohio Agr. Exp. Sta., Bull. No. 92, 1898, p. 208.

Yellows. — Conn. (State) Agr. Exp. Sta., Bull. No. 111, 1892, pp. 7, 8; also Bull. No. 115. Delaware Agr. Exp. Sta., Rept. 1893, pp. 152, 153; also Rept. 1897, pp. 168-173. Ga. Agr. Exp. Sta., Bull. No. 42, 1898, p. 220. Maryland Agr. Exp. Sta., Bull. No. 42, 1896, pp. 157-160. Mass. Bull. Bussey Inst. (Harvard Univ.), Vol. III., Pt. 1, 1901. Mass. Hatch Exp. Sta., Bull. No. 8, 1890, pp. 6-12. Mich. Agr. Exp. Sta., Bull. No. 103, 1894, pp. 46-53. N. J. Agr. Exp. Sta., Rept. 1898, pp. 357-359; also Rept. 1899, pp. 417, 418. N. Y. (Cornell Univ.) Agr. Exp. Sta., Bull. No. 25, 1890, pp. 178-180; also Bull. No. 75, 1894, pp. 392-408. No. Car. Agr. Exp. Sta., Bull. No. 92, 1893, pp. 101, 102, 112; also Bull. No. 120, 1895, pp. 300, 301. Ohio Agr. Exp. Sta., Bull. No. 104, 1899, pp. 212-216; also Bull. No. 92, 1898, pp. 190-199. Pa. Agr. Exp. Sta., Bull. No. 37, 1896, pp. 21-23. U. S. Dept. Agr., Div. Veg. Path., Bull. No. 4, 1893. U. S. Dept. Agr., Div. Veg. Path., Bull. No. 1, 1891. U. S. Dept. Agr., Farmers' Bull. No. 17, 1894. U. S. Dept. Agr., Sec. Veg. Path., Bull. No. 9, 1888. W. Va. Agr. Exp. Sta., Bull. No. 66, 1900, pp. 214, 215.

PEAR (*Pirus communis*, L.).

Frost Injuries. — Col. Agr. Exp. Sta., Bull. No. 41, 1898, pp. 15-18 (tree trunk). See *Plum* and *Peach*. Conn. (State) Agr. Exp. Sta., 19th Rept. 1895, p. 190 (on fruit). Vt. Agr. Exp. Sta., Bull. No. 49, 1895, p. 100 (on fruit). See *Apple*.

PLUM (*Prunus*, spp.).

Frost-cracks and Sun-scald. — Cal. Agr. Exp. Sta., Bull. No. 41, 1898, pp. 15-18. Del. Agr. Exp. Sta., Bull. No. 57, 1902, pp. 13-15.

Gummosis. — Ohio Agr. Exp. Sta., Bull. No. 79, 1897, pp. 121, 122. Oregon Agr. Exp. Sta., Bull. No. 45, 1897, pp. 68-72.

Yellows. — Consult *Peach* literature. Mass. Hatch Exp. Sta., Rept. 1903, p. 35.

POTATO (*Solanum tuberosum*, L.).

Arsenical Poisoning. — Vt. Agr. Exp. Sta., Bull. No. 49, 1895, pp. 97, 98; also Bull. No. 72, 1899, pp. 9, 10.

Internal Brown Rot. — Minn. Agr. Exp. Sta., Bull. No. 39, 1894, pp. 212, 213. Minn. Agr. Exp. Sta., Bull. No. 45, 1895, p. 310. N. Y. (Geneva) Agr. Exp. Sta., Bull. No. 101, pp. 78–83; also Rept. 1896, pp. 504–509.

Pimply Potatoes. — N. Y. (Geneva) Agr. Exp. Sta., Bull. No. 101, 1896, pp. 84, 85; also Rept. 1896, p. 511.

Stem-blight. — N. Y. (Geneva) Agr. Exp. Sta., Bull. No. 101, 1896, pp. 83, 84; also Bull. No. 138, 1897, pp. 632–634.

Sun-scald. — Vt. Agr. Exp. Sta., Bull. No. 72, 1899, pp. 12, 13.

Tip-burn. — U. S. Dept. Agr., Farmers' Bull. No. 91, p. 10. Vt. Agr. Exp. Sta., Bull. No. 49, 1895, pp. 98, 99; also Bull. No. 72, 1899, pp. 10–12.

QUINCE (*Pirus Cydonia*).

Frost-blisters (Leaves). — N. Y. (Geneva) Agr. Exp. Sta., Bull. No. 220, 1902, pp. 224, 225.

RASPBERRY (*Rubus*, spp.).

Yellows. — N. Y. (Geneva) Agr. Exp. Sta., Bull. No. 226, 1902, pp. 362–364.

RICE (*Oryza sativa*, L.).

Blast. — S. C. Agr. Exp. Sta., Bull. No. 41, 1899, pp. 3–7.

ROSE (*Rosa*, spp.).

Bronzing of Leaves. — Mass. Hatch Exp. Sta., Rept. 1899, pp. 156–159. N. J. Agr. Exp. Sta., Rept. 1891, pp. 303, 304.

TOBACCO (*Nicotiana Tabacum*, L.).

Mosaic Disease, "Calico" or Mottled Top. — Conn. (State) Agr. Exp. Sta., Rept. 1898, pp. 242–260; also Rept. 1899, pp. 252–261. U. S. Dept. Agr., Beau. Plant Indus., Bull. No. 18, 1902.

Spotting. — Conn. (State) Agr. Exp. Sta., Rept. 1898, pp. 254–260; also, Rept. 1899, pp. 252–261.

TOMATO (*Lycopersicum esculentum*, Mill.).

Dropping of Buds. — Fla. Agr. Exp. Sta., Bull. No. 21, 1893, pp. 37, 38; also Bull. No. 47, 1898, pp. 148–151.

Hollow Stem. — Fla. Agr. Exp. Sta., Bull. No. 47, 1898, pp. 151–153.

Œdema. — Fla. Agr. Exp. Sta., Bull. No. 47, 1898, pp. 146–148. N. Y. (Cornell Univ.) Agr. Exp. Sta., Bull. No. 53, 1893. Vt. Agr. Exp. Sta., 6th Rept. 1892, p. 88.

MISCELLANEOUS.

Arsenical Injuries. — Cal. Agr. Exp. Sta., Bull. No. 151, 1903.

Lichens, Mosses, etc. — Fla. Agr. Exp. Sta., Bull. No. 53, 1900, pp. 169–173.

Shade Trees. — Mechanical injuries, etc.: Conn. (State) Agr. Exp. Sta., Bull. No. 131, 1900; also 24th Rept. 1900, pp. 330–351. N. Y. (Cornell Univ.) Agr. Exp. Sta., Bull. No. 205, 1902.

Leaf-scorch or wilt: Vt. Agr. Exp. Sta., 13th Rept. 1899–1900, pp. 281, 282. Mass. Hatch Exp. Sta., Rept. 1897, pp. 81, 82. N. Y. (Geneva) Agr. Exp. Sta., Bull. No. 162, 1899, pp. 177, 178.

Illuminating gas, steam, etc.: Mass. Hatch Exp. Sta., Rept. 1899, pp. 163–167.

Loss of foliage: Mass. Hatch Exp. Sta., Rept. 1899, pp. 153, 154.

Current electricity, lightning: Mass. Hatch Exp. Sta., Bull. No. 91, 1903.

Sunstroke: Kentucky Agr. Exp. Sta., Bull. No. 47, 1893, pp. 6–8.

Smoke and Atmospheric Gases. — Pa. State Coll. Publication (Prof. Buckhout), 1900 (effects on trees). Utah Agr. Exp. Sta., Bull. No. 88, 1903 (effects on crops).

REPORT OF THE METEOROLOGIST.

J. E. OSTRANDER.

At the beginning of the year a change was made in the times of observation, from 7 A.M., 2 P.M. and 9 P.M. to 8 A.M. and 8 P.M. This was done in order to make them synchronous with those of the United States Weather Bureau, this station being one of the voluntary stations of that service. This change has made no appreciable difference in the daily means compared with those of previous years, excepting those of relative humidity, where the omission of the observation near midday seems to have resulted in a higher mean. The effect, however, can be more definitely determined after the change has been in operation for a number of years.

As in previous years, much of the work of this division has been that of observation and transcription of the records in permanent form. The usual bulletins have been regularly issued at the beginning of each month, containing the more important daily records, together with the monthly means, and remarks on any unusual features that occurred. An annual summary will be made a part of the December bulletin.

The local forecasts have been regularly received from the Boston office of the United States Weather Bureau, and the signals displayed from the flag-staff on the tower. This station is furnishing the weekly reports for the "snow and ice" bulletin, as has been done the last few years.

In addition to furnishing the section director of the Weather Bureau with the voluntary observers' reports, as well as our printed bulletin, at his request early in the year all the records at this station were examined and the data tabulated to be used in a climatological directory of the principal stations of the United States. A phenological record was also kept during the growing season, and two copies furnished the section director as requested.

As a part of the college exhibit for the Louisiana Purchase Exposition at St. Louis, this division prepared a number of charts in water colors, showing many of the meteorological features of the station. Photographs of most of our self-recording instruments were also sent.

Two new clocks for the Draper instruments were purchased during the year, to replace others that had become unreliable.

Mr. F. F. Henshaw retired as observer upon his graduation in June, and was succeeded by the assistant observer, Mr. G. W. Patch.

REPORT OF THE CHEMIST.

DIVISION OF FOODS AND FEEDING.

J. B. LINDSEY.

Chemical Assistants: E. B. HOLLAND, P. H. SMITH and E. S. FULTON.
Inspector of Feeds and Babcock Machines: ALBERT PARSONS.
Dairy Tester: SUMNER R. PARKER.
In Charge of Feeding Experiments: JOSEPH G. COOK.
Stenographer: MABEL C. SMITH.

PART I. — THE WORK OF THE YEAR.

1. Correspondence.
2. General laboratory work.
3. Character of laboratory work.
    - (*a*) Water.
    - (*b*) Dairy products and cattle feeds.
    - (*c*) Chemical investigations.
4. Inspection of concentrates.
5. Execution of the dairy law.
6. Test of pure-bred cows.
7. Work completed and in progress.
8. Changes in staff.

PART II. — EXPERIMENTS IN ANIMAL NUTRITION.

1. Digestion experiments with sheep.
2. The digestibility of galactan.
3. The feeding value of apple pomace.
4. Blomo feed for horses.

PART I. — THE WORK OF THE YEAR.

J. B. LINDSEY.

1. CORRESPONDENCE.

The general character of the correspondence has been much the same as in former years, and the amount has been approximately 4,000 letters and postals, in addition to some 1,000 circulars relative to adulterated mixed feeds.

2. GENERAL LABORATORY WORK.

The work in the laboratory has been of the same character as formerly. The number of determinations of butter fat in milk has greatly increased.

There have been sent in for examination 104 samples of water, 773 of milk, 1,779 of cream, 2 of butter and 153 of feed stuffs. In connection with experiments by this and other divisions of the station, there have been analyzed, in whole or in part, 234 samples of milk and cream and 530 of fodders and feed stuffs. There have also been collected and tested under the provision of the feed law 686 samples of concentrated feed stuffs. This makes a total of 4,261 substances analyzed during the year, as against 3,897 last year and 3,240 in the previous year. Work on the availability of organic nitrogen, not included in the above, has been done for the Association of Official Agricultural Chemists. In addition, 20 candidates have been examined and given certificates to operate Babcock machines, and 2,026 pieces of glassware have been tested for accuracy, of which 200 pieces, or 9.87 per cent., were condemned.

3. CHARACTER OF LABORATORY WORK.

(*a*) *Water.*

In accordance with instructions from the experiment station committee, this department continues to charge the sum of $3 for a sanitary analysis of water. The number of samples examined has been 104, which is considerably less than when the work was done free of cost. It is believed that this charge has held in check those who have heretofore abused the privilege by sending in a large number of samples, in some cases out of mere curiosity.

Instructions for securing an analysis of water: —

Those wishing to secure a sanitary analysis of water must first make application, whereupon a glass bottle securely encased, accompanied by full instructions for collecting and shipping the sample, will be forwarded by express. The return express must in all cases be prepaid. Because of the smallness of the sum involved, no account will be opened. Remittance by check, P. O. money order, or money at the owner's risk, must be strictly in advance.

Address Dr. J. B. LINDSEY,
Hatch Experiment Station, Amherst, Mass.

(*b*) *Dairy Products and Cattle Feeds.*

The station received about the usual number of samples of milk and cream. Many samples are sent by farmers to ascertain the quality of milk produced by their herd or by individual cows, and this should meet with every encouragement. Printed circulars are sent in answer to inquiries, giving concise information concerning the quality of milk produced by different breeds, as well as full instructions relative to the best methods of determining the productive capacity of the dairy herd. The station also tests a large number of samples of milk and cream for creameries at a charge sufficient to cover the cost.

About the usual number of feed stuffs were received during the year. These come from practical feeders, who either suspect adulteration, or desire to know the value of a feed new to their locality. The results of the examination are returned promptly, together with such information as is suited to the particular case. A considerable number of samples are also received from feed dealers, who wish to make sure as to the intrinsic value of the materials they are offering. It is believed that this desire for information should be encouraged as much as the limited resources of the department permit.

(c) *Chemical Investigations.*

In so far as time and opportunity permit, the department aims to make a study of chemical methods that will facilitate the accurate and rapid determinations of the different substances connected with animal or plant life. In this study of methods the department co-operates yearly with the Association of Official Agricultural Chemists.

4. INSPECTION OF CONCENTRATES.

The passage of the feed law by the Legislature of 1903 makes it possible to give the attention to this line of work which its importance demands. A regular inspector is now employed, who travels through the State from six to eight months in the year, so that the station is kept well informed regarding the variety and character of the feeds offered for sale. The results of the several inspections were published in Bulletins Nos. 93 and 98, issued in January and August. These bulletins contained 52 and 36 pages respectively. It may be said that the major portion of the feeds now offered are properly branded and free from adulteration; still, some manufacturers and local dealers continue to be careless about attaching the proper form of guarantee, and, while the station has not prosecuted any cases as yet, there will be no hesitation in doing so if occasion makes it necessary.

A tendency is noted on the part of both manufacturers and dealers to mix more or less oat offal or other filler with standard by-products, thus reducing the cost of the article sufficiently to enable them to slightly undersell their competitors. The station is taking a firm stand against such deceptions.

During the present autumn a considerable quantity of wheat mixed feed, bran and middlings, was found considerably adulterated with ground corn cobs and wheat screenings. The prompt attention of the jobbers was called to the matter, and they took steps immediately to attach the proper guarantee. A special circular relative to this fraud was sent to all the principal grain dealers in the State, as well as to the agricultural press.

It is not necessary to make a chemical analysis of as many samples as formerly. More attention is being given to the work of careful inspection and to the collecting of those samples which are suspected of being below standard or adulterated. The correspondence in connection with this police work, as it may be termed, requires a great deal of time and patience. It is believed that all farmers and dairymen can now keep themselves well posted upon the character and value of the large variety of feeds offered, if they are disposed to do so. Interested parties are referred to the various feed bulletins for details. Bulletin No. 101, comprising the results of the autumn inspection, is now in press, and will be issued during the present month (December).

5. Execution of the Dairy Law.

The enforcement of this law has been given the same careful attention as in previous years.

Inspection of Glassware. — All glassware found to be correctly graduated has been marked "Mass Ex St." There were 2,026 pieces examined, of which 200, or 9.87 per cent., were condemned. Inaccurate graduation of bottles has been rather more noticeable of late than at any time since the early days of the inspection. This is to be regretted, and it is hoped the manufacturers will take immediate action to prevent a possible recurrence. Bulb cream bottles (Bartlett) have been previously passed on accuracy of total graduation, as the usual charge of 5 cents apiece would not permit of additional testing. The continued use of these bottles by some of the prominent milk depots has rendered it necessary to test the three distinct portions of the scale, at a corresponding increase in cost.

Examination of Candidates. — A few more candidates than usual were examined, and 20 certificates of competency issued. A considerable number showed very poor manipulation, and lacked a thorough understanding of the method. In case of failure, applicants are obliged to wait a month before a second examination will be given.

Inspection of Babcock Machines. — The inspection of machines the present year has been in charge of Mr. Albert Parsons, who makes the following report: —

The annual inspection of Babcock machines was made in November of 1904. Fifty-six establishments were either visited or heard from, 36 being creameries and 20 milk depots. Twenty-one, or one-third the number, are co-operative, while the other 35 are proprietary, or managed by stock companies. Thirty-six machines were inspected. The number is 4 less than last year, due to the fact that 2 creameries and 1 milk depot have been discontinued, and 1 milk depot does not use its tester. Some machines overheated the tests, and a few required additional steam to warm them. One needed slight repairs of the steam gauge, but the others were in satisfactory condition, and in general showed an improvement over last year. Steam was the motive power in every case except one, where electricity was used. All but 5 of the machines have frames of cast iron, which is taking the place of galvanized iron and copper. Of the cast-iron machines, 19 are "Facile," 10 "Agos," and 2 "Wizard." The last named has only recently been placed upon the market. As a rule, the glassware was found in good condition, although in a few cases it was very dirty. In addition to the regular inspection, two city milk inspectors were visited. Each had a "Wizard" cast-iron machine, one being run by electricity and the other by a water motor. The electrical machine did not have sufficient power for the necessary speed. The other was in good condition, and a certificate was given.

6. TESTS OF PURE-BRED COWS.

This work has increased to such an extent as to render necessary the employment of a regular tester, Mr. Sumner R. Parker of the class of 1904 of this college, who gives it his whole time. The testing is conducted under the supervision of the American Guernsey and Jersey cattle clubs and the Holstein-Friesian Association. The work consists largely in determining the yearly milk and butter fat yields of pure-bred cows of the several breeds. The inspector visits the farms monthly, weighs the milk for one or two days, determines the butter fat by the Babcock method, and reports his findings to the secretary of the respective clubs, together with such other data, relative to feed, scattered milkings, etc., as are required. These tests are known as "yearly milk and butter fat tests," or "authenticated butter fat estimate and milk record." There are at present

51 Guernsey and Jersey cows under test, belonging to F. Lothrop Ames of North Easton, N. I. Bowditch of Framingham, W. L. Cutting of Pittsfield, R. F. and A. H. Parker of Westborough, A. H. Sagendorph of Spencer, C. I. Hood of Lowell, A. F. Pierce of Winchester, N. H., and R. A. Sibley of Spencer.

In addition, seven-day butter tests are occasionally called for by the Jersey Cattle Club, in which case it becomes necessary to weigh, sample and test not only the milk but the skim milk, buttermilk and butter; and the total fat in the three latter, together with that in the test samples, should balance the fat in the original milk, with the exception of small mechanical losses. The butter is analyzed at the station laboratory. Seven-day tests are also made for the Holstein-Friesian Association, which simply calls for the amount of milk and butter fat produced by the animal during that period.

7. Work completed and in Progress.

In addition to Bulletins Nos. 93 and 98, devoted to the inspection of feeding stuffs, this department has published during the year Bulletin No. 94, on distillery and brewery by-products, and Bulletin No. 99, on dried molasses beet pulp, and nutrition of horses. An experiment has been completed on the use of dried blood as a source of protein for milk production, showing that digestible protein in this material is equal in feeding value to a similar amount in cotton-seed meal. An experiment has also been completed with Pratts food as an aid to milk production. The results make clear that the claims put forward by the manufacturers relative to the wonderful influence of this food in increasing the quantity and quality of milk are entirely without foundation. Bibby's dairy cake has also been compared with gluten feed for the production of milk, and, while the results are not yet entirely tabulated, it is quite evident that the Bibby cake possesses no particular merits over other feed stuffs of a similar composition, and that the price asked is out of proportion to its actual feeding value. A number of experiments have been in progress with green forage crops, but, as the results at present are only of a tentative character, they will not be published until it is possible to deduce more definite conclusions.

Some 34 tons of corn and soy beans were grown together the past season on a little less than 3 acres of land, and the fodder ensiled. The silo has been recently opened, the silage appears in good condition and is readily eaten. It was not found possible to cut this mixture satisfactorily with a corn harvester, and the writer is forced to the conclusion that, until this can be accomplished, it will be doubtful economy to attempt to grow it to any extent for silage purposes. It is believed that the value of the extra protein obtained is more than offset by the increased cost of harvesting the crop.

Experiments are in progress relative to the value of molasses and molasses feeds as food for dairy stock and horses, and will occupy a considerable portion of the winter months. Attention is called to the several completed experiments published in Part II. of this report.

8. CHANGES IN STAFF.

Mr. W. E. Tottingham, employed in this department as assistant chemist for a year, resigned September 1 to continue his studies in the chemical department of the college. His work was very satisfactory. Mr. E. S. Fulton of the class of 1904 of the college succeeded Mr. Tottingham. Mr. S. R. Parker, another graduate of the class of 1904, began his duties August 1 as dairy tester. He is kept constantly employed in this line of work.

PART II. — EXPERIMENTS IN ANIMAL NUTRITION.

1. DIGESTION EXPERIMENTS WITH SHEEP.

J. B. LINDSEY.[1]

This station has given considerable time and study to the digestibility of coarse and concentrated cattle feeds. The first experiments were made in the autumn and winter of 1892–93, and the results published, together with a description of the method employed, in the eleventh report of the Massachusetts State Experiment Station. The results of further experiments were published in the twelfth report. A summary of all experiments made between 1894 and 1902 will be found in the fifteenth report of the Hatch Experiment Station, pp. 82–101. Experiments made during 1902 appeared in the sixteenth report of this station.

The experiments here described were made during the autumn of 1903 and winter and spring of 1904. The full data are here presented, with the exception of the daily production of manure and the daily water consumption, in which cases, to economize space, only averages are presented.

The period extended over fourteen days, the first seven of which were preliminary, collection of fæces being made during the last seven. Ten grams of salt were fed each sheep daily, in addition to the regular ration. Water was before the animals at all times.

Two lots of sheep, grade Southdown wethers, were employed in the several trials, known as the old and the young sheep. The former were five to six years of age, and had been used by the station for a number of years; the latter were dropped in 1902, and were employed for the first time during the autumn and winter of 1903–04.

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[1] With E. B. Holland, P. H. Smith, W. E. Tottingham and J. G. Cook.

The digestion coefficients for the digestion hay, used in calculating the results of the several experiments with the old sheep, were those obtained with Sheep II. and III., Sheep I. having been disposed of before the digestibility of the hay was determined.

The individual coefficients were used for the young sheep, being obtained from the average of the two trials in the case of Sheep I. and II., and that of the single trial for Sheep III.

Hay Coefficients used (Per Cent.).

	Old Sheep.	Young Sheep.		
		I.	II.	III.
Dry matter,	58.50	49.89	54.34	51.53
Ash,	22.00	13.86	22.60	16.55
Protein,	42.50	37.37	37.72	36.66
Fiber,	61.00	49.98	55.85	53.13
Extract matter,	64.00	56.29	59.77	57.02
Fat,	46.50	38.54	44.19	36.97

In calculating the digestion coefficients when English hay was used, excepting in periods IV., V. and XII., the average analysis of the two samples of hay was employed.

Composition of Feed Stuffs (Per Cent.).

[Dry matter.]

Feeds.	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
Soy bean fodder,	11.82	20.03	22.12	42.55	3.48
Waste soy bean fodder, Sheep II.,	8.64	4.85	55.47	30.33	.71
Eureka silage corn fodder,	6.19	9.34	27.41	55.52	1.54
Apple pomace,	3.05	5.13	16.10	69.32	6.40
Cotton-seed meal fed with pomace,	6.95	52.16	5.88	25.91	9.10
English hay fed to new sheep,	6.53	6.23	33.00	52.27	1.97
Waste English hay,[1] Sheep III., fine hay and seeds.	29.19	6.76	21.67	40.25	2.13
English hay fed to old sheep,	6.35	6.24	31.95	53.15	2.31
Bibby's dairy cake,	9.14	23.52	9.28	48.06	10.00
Bibby's dairy cake (1903),	8.38	21.39	9.19	50.42	10.62
Alma dried molasses-beet-pulp,	5.64	9.87	17.17	66.74	.58

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[1] Contained 21.39 per cent. of salt.

Composition of Feed Stuffs (Per Cent.) — Concluded.

[Dry matter.]

FEEDS.	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
Armour's blood meal,	3.37	95.24	.88	-	.51
Corn meal fed with blood meal,	1.41	9.87	2.09	82.25	4.38
Soy bean meal, coarse ground,	5.73	40.69	4.71	27.77	21.10
Hominy feed,	3.15	11.66	5.46	70.11	9.62
Hominy meal (1903),	3.38	12.23	4.97	69.43	9.99
Eureka silage corn fodder (dry),	7.85	9.82	32.70	47.90	1.73
Waste corn stover, Sheep II.,	9.85	9.16	34.13	45.07	1.79
English hay,[1]	6.46	6.74	32.28	52.16	2.36
Waste English hay, Sheep I.,	6.94	6.17	32.72	52.05	2.12
Waste English hay,[2] Sheep II.,	14.99	6.95	27.41	48.22	2.43

[1] Used in Period XII.

[2] Contained 7.38 per cent. of salt.

Composition of Fæces (Per Cent.).

[Dry matter.]

Old Sheep I.

Period.	FEEDS.	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
I.,	Soy bean fodder,	18.55	8.62	33.83	35.99	3.01
II.,	Eureka silage corn fodder,	9.87	8.77	33.67	46.28	1.41
III.,	Apple pomace,	9.93	18.53	24.38	40.21	6.95
XXVI. (1903),	Bibby's dairy cake,	12.88	14.93	27.19	41.62	3.38
XXVIII. (1903),	Hominy meal,	11.31	13.41	28.49	43.33	3.46

Old Sheep II.

Period.	FEEDS.	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
I.,	Soy bean fodder,	19.95	9.44	33.48	34.05	3.08
II.,	Eureka silage corn fodder,	11.47	9.85	31.70	45.30	1.68
III.,	Apple pomace,	9.93	17.97	23.24	41.07	7.79
V.,	English hay,	11.78	8.42	30.93	46.03	2.84
VII.,	Alma dried molasses-beet-pulp,	12.37	10.80	29.21	44.15	3.47
IX.,	Soy bean meal,	12.87	9.82	29.50	44.64	3.17
XI.,	Eureka silage corn fodder (dry),	12.73	11.58	26.04	47.87	1.78
XXVI. (1903),	Bibby's dairy cake,	13.89	14.86	26.54	41.23	3.48
XXVIII. (1903),	Hominy meal,	12.91	14.22	25.99	43.21	3.67

Composition of Fæces (Per Cent.) — Concluded.

[Dry matter.]

Old Sheep III.

Period.	**Feeds.**	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
I., . .	Soy bean fodder, ...	19.96	9.34	32.18	35.34	3.18
II., . .	Eureka silage corn fodder, . .	10.92	9.14	32.41	45.89	1.64
III., . .	Apple pomace, ...	11.44	20.82	19.82	40.40	7.52
V., . .	English hay, ...	12.15	9.01	29.49	46.18	3.17
VII., . .	Alma dried molasses-beet-pulp, .	12.51	11.21	27.82	45.04	3.42
IX., . .	Soy bean meal, ...	12.02	10.67	26.56	46.96	3.79
XI., . .	Eureka silage corn fodder (dry), .	12.79	11.84	25.27	48.29	1.81
XXVI. (1903),	Bibby's dairy cake, ...	13.98	15.59	24.63	41.87	3.96
XXVIII. (1903),	Hominy meal, ...	13.06	14.88	24.06	43.41	4.59

Young Sheep I.

Period.	**Feeds.**	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
IV., . . .	English hay, ...	11.16	7.86	32.51	45.75	2.72
VI., . . .	Bibby's dairy cake, ...	12.62	11.19	30.20	43.41	2.58
VIII., . . .	Armour's blood meal, . . .	10.64	13.03	31.49	42.29	2.55
X., . . .	Marshall's hominy feed, . .	10.98	10.81	29.89	45.47	2.85
XII., . . .	English hay, ...	11.12	8.88	32.64	45.84	2.52

Young Sheep II.

Period.	**Feeds.**	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
IV., . . .	English hay, ...	10.70	8.40	31.51	46.74	2.65
VI., . . .	Bibby's dairy cake, ...	12.03	12.50	30.29	42.61	2.57
VIII., . . .	Armour's blood meal, . . .	10.47	15.57	29.30	42.23	2.43
X., . . .	Marshall's hominy feed, . .	10.72	11.30	30.08	45.36	2.54
XII., . . .	English hay, ...	11.21	9.26	31.72	45.24	2.57

Young Sheep III.

Period.	**Feeds.**	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
IV., . . .	English hay, ...	10.92	7.97	32.20	46.40	2.51
VI., . . .	Bibby's dairy cake, ...	12.90	11.08	31.30	42.36	2.36
X., . . .	Marshall's hominy feed, . .	10.62	9.97	30.60	46.14	2.67

Dry Matter Determinations made at Time of Weighing out the Different Foods, and Dry Matter in Manure excreted, determined from Air-dry Fæces (Per Cent.).

Old Sheep I.

PERIODS.	English Hay.	Soy Bean Fodder.	Eureka Silage Corn Fodder.	Apple Pomace.	Cotton-seed Meal.	Alma Dried Molasses-beet-pulp.	Soy Bean Meal.	Eureka Silage Corn Fodder (Dry).	Bibby's Dairy Cake.	Hominy Meal.	Waste.	Manure.
I.,	87.27	23.94	-	-	-	-	-	-	-	-	-	91.02
II.,	-	-	17.42	-	-	-	-	-	-	-	-	89.82
III.,	87.05	-	-	19.83	89.34	-	-	-	-	-	-	92.28
XXVI. (1903),	88.82	-	-	-	-	-	-	-	89.80	-	-	92.43
XXVIII. (1903),	88.25	-	-	-	-	-	-	-	-	88.48	-	92.98

Old Sheep II.

PERIODS.	English Hay.	Soy Bean Fodder.	Eureka Silage Corn Fodder.	Apple Pomace.	Cotton-seed Meal.	Alma Dried Molasses-beet-pulp.	Soy Bean Meal.	Eureka Silage Corn Fodder (Dry).	Bibby's Dairy Cake.	Hominy Meal.	Waste.	Manure.
I.,	87.27	23.94	-	-	-	-	-	-	-	-	96.37	90.82
II.,	-	-	17.42	-	-	-	-	-	-	-	-	89.98
III.,	87.05	-	-	19.83	89.34	-	-	-	-	-	-	92.00
V.,	88.10	-	-	-	-	-	-	-	-	-	-	92.50
VII.,	87.82	-	-	-	-	92.62	-	-	-	-	-	93.55
IX.,	88.37	-	-	-	-	-	86.96	-	-	-	-	94.42
XI.,	-	-	-	-	-	-	-	40.08	-	-	51.19	93.84
XXVI. (1903),	88.82	-	-	-	-	-	-	-	89.80	-	-	92.66
XXVIII. (1903),	88.25	-	-	-	-	-	-	-	-	88.48	-	92.54

Old Sheep III.

PERIODS.	English Hay.	Soy Bean Fodder.	Eureka Silage Corn Fodder.	Apple Pomace.	Cotton-seed Meal.	Alma Dried Molasses-beet-pulp.	Soy Bean Meal.	Eureka Silage Corn Fodder (Dry).	Bibby's Dairy Cake.	Hominy Meal.	Waste.	Manure.
I.,	87.27	23.94	-	-	-	-	-	-	-	-	-	90.77
II.,	-	-	17.42	-	-	-	-	-	-	-	-	89.81
III.,	87.05	-	-	19.83	89.34	-	-	-	-	-	-	91.88
V.,	88.10	-	-	-	-	-	-	-	-	-	-	92.56
VII.,	87.82	-	-	-	-	92.62	-	-	-	-	-	93.60
IX.,	88.37	-	-	-	-	-	86.96	-	-	-	-	94.61
XI.,	-	-	-	-	-	-	-	40.08	-	-	-	93.84
XXVI. (1903),	88.82	-	-	-	-	-	-	-	89.80	-	-	92.84
XXVIII. (1903),	88.25	-	-	-	-	-	-	-	-	88.48	-	92.91

Dry Matter Determinations, etc. — Concluded.

Young Sheep I.

PERIODS.	English Hay.	Bibby's Dairy Cake.	Armour's Blood Meal.	Corn Meal.	Marshall's Hominy Feed.	Waste.	Manure.
IV., . .	87.90	-	-	-	-	86.65	93.36
VI., . .	88.05	89.45	-	-	-	-	93.78
VIII., . .	87.85	-	88.70	86.13	-	-	93.45
X., . .	89.30	-	-	-	88.53	-	94.06
XII., . .	89.77	-	-	-	-	87.00	93.22

Young Sheep II.

PERIODS.	English Hay.	Bibby's Dairy Cake.	Armour's Blood Meal.	Corn Meal.	Marshall's Hominy Feed.	Waste.	Manure.
IV., . .	87.90	-	-	-	-	-	93.27
VI., . .	88.05	89.45	-	-	-	-	93.55
VIII., . .	87.85	-	88.70	86.13	-	-	93.33
X., . .	89.30	-	-	-	88.53	-	93.78
XII., . .	89.77	-	-	-	-	87.80	92.84

Young Sheep III.

PERIODS.	English Hay.	Bibby's Dairy Cake.	Armour's Blood Meal.	Corn Meal.	Marshall's Hominy Feed.	Waste.	Manure.
IV., . .	87.90	-	-	-	-	88.50	93.25
VI., . .	88.05	89.45	-	-	-	-	94.16
X., . .	89.30	-	-	-	88.53	87.80	94.08

Average Daily Amount of Manure excreted and Water drank (Grams).

Period.	CHARACTER OF RATION.	OLD SHEEP I.			OLD SHEEP II.			OLD SHEEP III.		
		Manure excreted daily.	Sample Air Dry.	Water drank daily.	Manure excreted daily.	Sample Air Dry.	Water drank daily.	Manure excreted daily.	Sample Air Dry.	Water drank daily.
I.,	Soy bean fodder,	699	35.09	1,409	684	34.26	1,492	679	34.67	1,296
II.,	Eureka silage corn fodder,	630	23.53	-	506	20.70	-	481	21.77	-
III.,	Apple pomace,	669	27.29	536	581	24.68	414	818	25.95	-
V.,	English hay,	-	-	-	806	36.94	1,067	717	33.92	1,391
VII.,	Alma dried molasses-beet-pulp,	-	-	-	613	27.13	1,379	623	28.69	1,386
IX.,	Soy bean meal,	-	-	-	736	27.48	1,264	860	30.62	1,638
XI.,	Eureka silage corn fodder (dry),	-	-	-	400	16.61	516	506	18.55	1,006
XXVI. (1903),	Bibby's dairy cake,	923	31.86	2,370	708	27.13	1,688	784	30.68	1,992
XXVIII. (1903),	Hominy meal,	700	28.73	2,500	825	26.25	2,017	637	23.14	2,198

Average Daily Amount of Manure excreted, etc. — Concluded.

Period.	CHARACTER OF RATION.	YOUNG SHEEP I.			YOUNG SHEEP II.			YOUNG SHEEP III.		
		Manure excreted daily.	Sample Air Dry.	Water drank daily.	Manure excreted daily.	Sample Air Dry.	Water drank daily.	Manure excreted daily.	Sample Air Dry.	Water drank daily.
IV.,	English hay,	979	39.76	1,309	881	37.47	2,477	875	36.80	1,827
VI.,	Bibby's dairy cake,	956	32.47	1,368	881	32.52	2,156	915	32.09	2,104
VIII.,	Armour's blood meal,	628	27.88	1,369	628	27.72	2,266	-	-	-
X.,	Marshall's hominy feed,	837	29.49	1,339	912	29.16	1,894	844	30.87	2,076
XII.,	English hay,	904	35.06	1,354	799	33.20	2,467	-	-	-

Weights of Animals at Beginning and End of Period (Pounds).

Period.	CHARACTER OF RATION.	OLD SHEEP I.		OLD SHEEP II.		OLD SHEEP III.	
		Beginning.	End.	Beginning.	End.	Beginning.	End.
I.,	Soy bean fodder,	167.25	168.00	154.50	155.25	152.75	149.50
II.,	Eureka silage corn fodder,	167.50	164.75	156.00	154.50	149.00	145.75
III.,	Apple pomace,	170.75	171.50	157.50	158.25	152.75	153.50
V.,	English hay,	-	-	164.00	162.00	159.50	160.00
VII.,	Alma dried molasses-beet-pulp,	-	-	162.00	162.75	160.50	160.25
IX.,	Soy bean meal,	-	-	163.00	163.25	161.00	158.25
XI.,	Eureka silage corn fodder (dry),	-	-	159.75	157.00	158.75	153.50
XXVI. (1903),	Bibby's dairy cake,	159.00	154.75	155.00	154.25	149.00	146.75
XXVIII. (1903),	Hominy meal,	156.75	152.00	157.25	156.50	150.25	149.00

Weights of Animals, etc. — Concluded.

Period.	CHARACTER OF RATION.	YOUNG SHEEP I.		YOUNG SHEEP II.		YOUNG SHEEP III.	
		Beginning.	End.	Beginning.	End.	Beginning.	End.
IV.,	English hay,	98.50	95.00	97.00	98.25	97.00	96.00
VI.,	Bibby's dairy cake,	95.25	98.00	98.75	92.25	90.25	90.75
VIII.,	Armour's blood meal,	96.25	97.50	91.25	98.50	-	-
X.,	Marshall's hominy feed,	94.00	94.50	88.00	90.25	89.00	89.25
XII.,	English hay,	98.75	96.50	91.50	94.25	-	-

Period I.

Old Sheep I.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
400 grams English hay,	349.08	22.48	21.78	113.38	183.97	7.47
2,000 grams soy bean fodder,	478.80	56.59	95.90	105.91	203.73	16.66
Amount consumed,	827.88	79.07	117.68	219.29	387.70	24.13
350.87 grams manure excreted,	319.36	59.24	27.53	108.04	114.94	9.61
Grams digested,	508.52	19.83	90.15	111.25	272.76	14.52
Minus hay digested,	204.21	4.95	9.26	69.16	117.74	3.47
Soy bean fodder digested,	304.31	14.88	80.89	42.09	155.02	11.05
Per cent. digested,	63.56	26.29	84.35	39.74	76.09	66.33

Old Sheep II.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
2,000 grams soy bean fodder fed,	478.80	56.59	95.90	105.91	203.73	16.66
Minus 38 grams waste,	34.69	3.00	1.69	19.24	10.52	.25
Soy bean fodder consumed,	444.11	53.59	94.22	86.67	193.21	16.41
400 grams English hay,	349.08	22.48	21.78	113.38	183.97	7.47
Amount consumed,	773.19	76.07	116.00	200.05	377.18	23.88
342.59 grams manure excreted,	311.14	62.07	29.37	104.17	105.94	9.58
Grams digested,	482.05	14.00	86.63	95.88	271.24	14.30
Minus hay digested,	204.21	4.95	9.26	69.16	117.74	3.47
Soy bean digested,	277.84	9.05	77.37	26.72	153.50	10.83
Per cent. digested,	62.51	16.89	82.12	30.83	79.45	66.00

Old Sheep III.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Amount consumed same as for Sheep I.,	827.88	79.07	117.68	219.29	387.70	24.13
346.71 grams manure excreted,	314.71	62.82	29.39	101.27	111.22	10.01
Grams digested,	513.17	16.25	88.29	118.02	276.48	14.12
Minus hay digested,	204.21	4.95	9.26	69.16	117.74	3.47
Soy bean fodder digested,	308.96	11.30	79.03	48.86	158.74	10.65
Per cent. digested,	64.53	19.97	82.41	46.13	77.92	63.93
Average per cent. three sheep digested,	**63.53**	**21.05**	**82.96**	**38.90**	**77.82**	**65.42**

Period II.

Old Sheep I.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
3,400 grams Eureka silage corn,	**592.28**	**36.66**	**55.32**	**162.34**	**328.83**	**9.12**
235.29 grams manure excreted,	**211.34**	**20.86**	**18.53**	**71.16**	**97.81**	**2.98**
Grams digested,	**380.94**	**15.80**	**36.79**	**91.18**	**231.02**	**6.14**
Per cent. digested,	**64.32**	**43.10**	**66.50**	**56.17**	**70.26**	**67.32**

Old Sheep II.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
3,400 grams Eureka silage corn,	**592.28**	**36.66**	**55.32**	**162.34**	**328.83**	**9.12**
207.01 grams manure excreted,	**186.16**	**21.35**	**18.34**	**59.01**	**84.33**	**3.13**
Grams digested,	**406.12**	**15.31**	**36.98**	**103.33**	**244.50**	**5.99**
Per cent. digested,	**68.57**	**41.76**	**66.85**	**63.65**	**74.35**	**65.68**

Old Sheep III.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
3,400 grams Eureka silage corn,	**592.28**	**36.66**	**55.32**	**162.34**	**328.83**	**9.12**
217.69 grams manure excreted,	**195.51**	**21.35**	**17.87**	**63.36**	**89.72**	**3.21**
Grams digested,	**396.77**	**15.31**	**37.45**	**98.98**	**239.11**	**5.91**
Per cent. digested,	**66.99**	**41.76**	**67.70**	**60.97**	**72.72**	**64.80**
Average per cent. three sheep digested,	**66.63**	**42.21**	**67.02**	**60.26**	**72.44**	**65.93**

Period III.

Old Sheep I.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
250 grams English hay,	217.63	14.02	13.58	70.69	114.69	4.66
150 grams cotton-seed meal,	134.01	9.31	69.90	7.88	34.72	12.19
2,000 grams apple pomace,	396.60	12.10	20.35	63.85	274.92	25.38
Amount consumed,	748.24	35.43	103.83	142.42	424.33	42.23
272.89 grams manure excreted,	251.82	25.01	46.66	61.39	101.26	17.50
Grams digested,	496.42	10.42	57.17	81.03	323.07	24.73
Minus hay digested,	127.31	3.08	5.77	43.12	73.40	2.17
	369.11	7.34	51.40	37.91	249.67	22.56
Minus cotton-seed meal digested,	101.85	2.23	61.51	2.52	22.22	11.34
Apple pomace digested,	267.26	5.11	-	35.39	227.45	11.22
Per cent. digested,	67.39	42.23	-	55.43	82.73	44.21

Old Sheep II.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Amount consumed as above,	748.24	35.43	103.83	142.42	424.33	42.33
246.76 grams manure excreted,	227.02	22.54	40.80	52.76	93.24	17.68
Grams digested,	521.22	12.89	63.03	89.66	331.09	24.55
Minus hay and cotton-seed meal digested,	229.16	5.31	67.28	45.64	95.62	13.51
Apple pomace digested,	292.06	7.58	-	44.02	235.47	11.04
Per cent. digested,	73.64	62.64	-	68.94	85.65	43.50

Old Sheep III.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Amount consumed as above,	748.24	35.43	103.83	142.42	424.33	42.23
259.46 grams manure excreted,	238.39	27.27	49.63	47.25	96.31	17.93
Grams digested,	509.85	8.16	54.20	95.17	328.02	24.30
Minus hay and cotton-seed meal digested,	229.16	5.31	67.28	45.64	95.62	13.51
Apple pomace digested,	280.69	2.85	-	49.53	232.40	10.79
Per cent. digested,	70.77	23.55	-	77.57	84.53	42.51
Average per cent. three sheep digested,	**70.60**	**42.81**	-	**67.31**	**84.30**	**43.41**

Period IV.

Young Sheep I.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
850 grams English hay,	747.15	48.79	46.55	246.56	390.54	14.72
Minus 35.86 grams waste,	31.07	2.03	1.94	10.25	16.24	.61
Amount consumed,	716.08	46.76	44.61	236.31	374.30	14.11
397.61 grams manure excreted,	371.21	41.43	29.18	120.68	169.83	10.10
Grams digested,	344.87	5.33	15.43	115.63	204.47	4.01
Per cent. digested,	48.16	11.40	34.59	48.93	54.63	28.42

Young Sheep II.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
850 grams English hay,	747.15	48.79	46.55	246.56	390.54	14.72
374.71 grams manure excreted,	349.49	37.40	29.36	110.12	163.35	9.26
Grams digested,	397.66	11.39	17.19	136.44	227.19	5.46
Per cent. digested,	53.22	23.34	36.93	55.34	58.17	37.09

Young Sheep III.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
850 grams English hay,	747.15	48.79	46.55	246.56	390.54	14.72
Minus 56.29 grams waste,	39.16	3.89	3.37	10.80	20.05	1.06
Amount consumed,	707.99	44.90	43.18	235.76	370.49	13.66
368.01 grams manure excreted,	343.17	37.47	27.35	110.50	159.23	8.61
Grams digested,	364.82	7.43	15.83	125.26	211.26	5.05
Per cent. digested,	51.53	16.55	36.66	53.13	57.02	36.97
Average per cent. three sheep digested,	**50.97**	**17.10**	**36.06**	**52.47**	**56.61**	**34.16**

Period V.

Old Sheep II.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
900 grams English hay, ...	792.90	50.35	49.48	253.33	421.43	18.32
369.38 grams manure excreted, ...	341.68	40.25	28.77	105.68	157.28	9.70
Grams digested, ...	451.22	10.10	20.71	147.65	264.15	8.62
Per cent. digested, ...	56.91	20.06	41.86	58.28	62.68	47.05

Old Sheep III.

900 grams English hay, ...	792.90	50.35	49.48	253.33	421.43	18.32
339.15 grams manure excreted, ...	313.92	38.14	28.28	92.58	144.97	9.95
Grams digested, ...	478.98	12.21	21.20	160.75	276.46	8.37
Per cent. digested, ...	60.41	24.25	42.85	63.45	65.60	45.69
Average per cent. two sheep digested, . .	**58.66**	**22.16**	**42.36**	**60.87**	**64.14**	**46.37**

Period VI.

Young Sheep I.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
600 grams English hay,	528.30	34.02	32.97	171.59	278.41	11.31
200 grams Bibby's dairy cake,	178.90	16.35	42.08	16.60	85.98	17.89
Amount consumed,	707.20	50.37	75.05	188.19	364.39	29.20
324.71 grams manure excreted,	304.51	38.43	34.07	91.96	132.19	7.86
Grams digested,	402.69	11.94	40.98	96.23	232.20	21.34
Minus hay digested,	263.57	4.72	12.32	85.76	156.72	4.36
Bibby's dairy cake digested,	139.12	7.22	28.66	10.47	75.48	16.98
Per cent. digested,	77.76	44.16	68.11	63.07	87.79	94.91

Young Sheep II.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Amount consumed as above,	707.20	50.37	75.05	188.19	364.39	29.20
325.20 grams manure excreted,	304.22	36.60	38.03	92.15	129.63	7.82
Grams digested,	402.98	13.77	37.02	96.04	234.76	21.38
Minus hay digested,	287.08	7.69	12.44	95.83	166.41	5.00
Bibby's dairy cake digested,	115.90	6.08	24.58	.21	68.35	16.38
Per cent. digested,	64.78	37.19	58.41	1.27	79.50	91.56

Young Sheep III.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Amount consumed as above,	707.20	50.37	75.05	188.19	364.39	29.20
329.87 grams manure excreted,	310.61	40.07	34.42	97.22	131.57	7.33
Grams digested,	396.59	10.30	40.63	90.97	232.82	21.87
Minus hay digested,	272.23	5.63	12.09	91.17	158.75	4.18
Bibby's dairy cake digested,	24.36	4.67	28.54	.20	74.07	17.69
Per cent. digested,	69.51	28.56	67.82	–	86.15	98.88
Average per cent. three sheep digested,	70.68	36.64	64.78	32.17	84.48	95.12

Period VII.

Old Sheep II.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
600 grams English hay,	526.92	33.93	32.88	171.14	277.69	11.28
300 grams beet pulp,	277.86	15.67	27.42	47.71	185.44	1.61
Amount consumed,	804.78	49.60	60.30	218.85	463.13	12.89
271.34 grams manure excreted,	253.84	31.40	27.41	74.15	112.07	8.81
Grams digested,	550.94	18.20	32.89	144.70	351.06	4.08
Minus hay digested,	308.25	7.46	13.97	104.40	177.72	5.25
Beet pulp digested,	241.69	10.74	18.92	40.30	173.34	-
Per cent. digested,	86.98	68.54	69.00	84.47	93.47	-

Old Sheep III.

Amount consumed as above,	804.78	49.60	60.30	218.85	463.13	12.89
286.94 grams manure excreted,	268.58	33.60	30.11	74.72	120.97	9.19
Grams digested,	536.20	16.00	30.19	144.13	342.16	3.70
Minus hay digested,	308.25	7.46	13.97	104.40	177.72	5.25
Beet pulp digested,	227.95	8.54	16.22	39.73	164.44	-
Per cent. digested,	82.04	54.50	59.15	83.27	88.68	-
Average per cent. two sheep digested,	**84.51**	**61.52**	**64.08**	**83.87**	**91.08**	-

Period VIII.

Young Sheep I.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
600 grams English hay,	527.10	33.95	32.89	171.20	277.78	11.28
100 grams corn meal,	86.13	1.21	8.50	1.80	70.84	3.77
100 grams Armour's blood meal,	88.70	2.99	84.48	.78	-	.45
Amount consumed,	701.93	38.15	125.87	173.78	348.62	15.50
278.77 grams manure excreted,	260.51	27.72	33.94	82.03	110.17	6.64
Grams digested,	441.42	10.43	91.93	91.75	238.45	8.86
Minus hay digested,	262.97	4.71	12.29	85.57	156.36	4.35
	178.45	5.72	79.64	6.18	82.09	4.51
Minus corn meal digested,	76.66	-	5.95	-	66.59	3.43
Blood meal digested,	101.79	-	73.69	-	15.50	1.08
Per cent. digested,	100.+	-	88.41	-	-	-

Young Sheep II.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Amount consumed as above,	701.93	38.15	125.87	173.78	348.62	15.50
277.21 grams manure excreted,	258.72	27.09	40.28	75.80	109.26	6.29
Grams digested,	443.21	11.06	85.59	97.98	239.36	9.21
Minus hay and corn meal digested,	363.09	7.67	18.36	95.62	166.03	4.98
Blood meal digested,	80.12	3.39	67.23	2.36	73.33	4.23
Per cent. digested,	90.33	-	79.58	-	-	-
Average per cent. two sheep digested,	-	-	84.00	-	-	-

Period IX.

Old Sheep II.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
700 grams English hay,	618.59	39.84	38.59	200.92	326.00	13.24
200 grams soy bean meal,	173.92	9.97	70.77	8.19	48.30	36.70
Amount consumed,	792.51	49.81	109.36	209.11	374.30	49.94
274.77 grams manure excreted,	259.44	33.39	25.48	76.53	115.81	8.22
Grams digested,	533.07	16.42	83.88	132.58	258.49	41.72
Minus hay digested,	361.88	8.76	16.40	122.56	208.64	6.16
Soy bean meal digested,	171.19	7.66	67.48	10.02	49.85	35.56
Per cent. digested,	98.43	76.83	95.35	122.20	103.20	96.89

Old Sheep III.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Amount consumed as above,	792.51	49.81	109.36	209.11	374.30	49.94
306.24 grams manure excreted,	289.73	34.83	30.91	76.95	136.06	10.98
Grams digested,	502.78	14.98	78.45	132.16	238.24	38.96
Minus hay digested,	361.88	8.76	16.40	122.56	208.64	6.16
Soy bean meal digested,	140.90	6.22	62.05	9.60	29.60	32.80
Per cent. digested,	81.01	62.39	87.68	104.90	61.28	89.37
Average per cent. two sheep digested,	**89.72**	**69.61**	**91.51**	**113.55**	**82.24**	**93.13**

Period X.

Young Sheep I.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
550 grams English hay,	491.15	31.63	30.65	159.53	258.84	10.51
250 grams hominy feed,	221.33	6.97	25.81	12.08	155.17	21.29
Amount consumed,	712.48	38.60	56.46	171.61	414.01	31.80
294.91 grams manure excreted,	277.39	30.46	29.99	82.91	126.13	7.91
Grams digested,	435.09	8.14	26.47	88.70	287.88	23.89
Minus hay digested,	244.93	4.38	11.45	79.73	145.70	4.05
Hominy feed digested,	190.16	3.76	15.02	8.97	142.18	19.84
Per cent. digested,	85.87	53.95	58.19	74.25	91.63	93.19

Young Sheep II.

Amount consumed as above,	712.48	38.60	56.46	171.61	414.01	31.80
291.64 grams manure excreted,	273.50	29.32	30.91	82.27	124.06	6.95
Grams digested,	438.98	9.28	25.55	89.34	289.95	24.85
Minus hay digested,	266.89	7.15	11.56	89.10	154.71	4.64
Hominy feed digested,	172.09	2.13	13.99	.24	135.24	20.21
Per cent. digested,	77.75	30.56	54.20	1.99	87.16	94.88

Young Sheep III.

550 grams English hay,	491.15	-	-	-	-	-
Minus 8.86 grams waste hay,	7.78	-	-	-	-	-
Total hay consumed,	483.37	31.13	30.16	157.00	254.74	10.34
250 grams hominy feed,	221.33	6.97	25.81	12.08	155.17	21.29
Amount consumed,	704.70	38.10	55.97	169.08	409.91	31.63
308.66 grams manure excreted,	290.39	30.84	28.95	88.86	133.99	7.75
Grams digested,	414.31	7.26	27.02	80.22	275.92	23.88
Minus hay digested,	249.08	5.15	11.06	83.41	145.25	3.82
Hominy feed digested,	165.23	2.11	15.96	-	130.67	20.06
Per cent. digested,	74.65	30.27	61.84	-	84.21	94.22
Average per cent. three sheep digested,	**79.42**	**38.26**	**58.08**	**38.12**	**87.67**	**94.10**

Period XI.

Old Sheep II.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
1,200 grams Eureka silage corn fodder (dry), .	480.96	37.76	47.23	157.27	230.38	8.32
Minus 96.86 grams waste, ...	49.58	4.88	4.54	16.92	22.35	.89
Amount consumed, ...	431.38	32.88	42.69	140.35	208.03	7.43
168.06 grams manure excreted, ...	155.83	19.84	18.05	40.58	74.60	2.77
Grams digested, ...	275.55	13.04	24.64	99.77	133.43	4.66
Per cent. digested, ...	63.88	39.66	57.72	71.09	64.14	62.72

Old Sheep III.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
1,200 grams Eureka silage corn fodder (dry), .	480.96	37.76	47.23	157.27	230.38	8.32
185.54 grams manure excreted, ...	174.11	22.27	20.61	44.00	84.08	3.15
Grams digested, ...	306.85	15.49	26.62	113.27	146.30	5.17
Per cent. digested, ...	63.80	41.02	56.36	72.02	63.50	62.14
Average per cent. two sheep digested, . .	63.84	40.34	57.04	71.56	63.82	62.43

Period XII.

Young Sheep I.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
800 grams English hay,	718.16	46.39	48.40	231.82	374.59	16.95
Minus 48.57 grams waste,	42.26	2.93	2.61	13.83	22.00	.90
Amount consumed,	675.90	43.46	45.79	217.99	352.59	16.05
350.83 grams manure excreted,	327.04	36.37	27.41	106.75	148.28	8.24
Grams digested,	348.86	7.09	18.38	111.24	204.31	7.81
Per cent. digested,	51.61	16.31	40.14	51.03	57.95	48.66

Young Sheep II.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
800 grams English hay,	718.16	46.39	48.40	231.82	374.59	16.95
Minus 32.57 grams waste,	26.27	2.18	1.99	7.84	13.79	.69
Amount consumed,	691.89	44.21	46.41	223.98	360.80	16.26
331.97 grams manure excreted,	308.20	34.55	28.54	97.76	139.43	7.92
Grams digested,	383.69	9.66	17.84	126.22	221.37	8.34
Per cent. digested,	55.46	21.85	38.50	56.35	61.36	51.29
Average per cent. two sheep digested,	53.54	19.08	39.32	53.69	59.66	49.98

Period XXVI. (1903).

Old Sheep I.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
650 grams hay,	577.83	44.05	69.45	182.44	264.94	16.45
250 grams Bibby's dairy cake,	224.50	18.81	48.02	20.63	113.19	23.84
Total consumed,	801.83	62.86	117.47	203.07	378.13	40.29
318.61 grams manure excreted,	294.49	37.93	43.97	80.07	122.57	9.95
Amount digested,	507.34	24.93	73.50	123.00	255.56	30.34
Minus hay digested,	369.49	19.82	43.75	122.23	174.86	8.88
Bibby's dairy cake digested,	137.85	5.11	29.75	.77	80.70	21.46
Per cent. digested,	61.40	27.16	61.96	-	71.29	90.02

Old Sheep II.

Total consumed as above,	801.83	62.86	117.47	203.07	378.13	40.29
271.31 grams manure excreted,	251.40	34.92	37.36	66.72	103.65	8.75
Amount digested,	550.43	27.94	80.11	136.35	274.48	31.54
Minus hay digested,	369.49	19.82	43.75	122.23	174.86	8.88
Bibby's dairy cake digested,	180.94	8.12	36.36	14.12	99.62	22.66
Per cent. digested,	80.59	43.17	75.72	68.44	88.01	95.05

Old Sheep III.

Total consumed as above,	801.83	62.86	117.47	203.07	378.13	40.29
306.77 grams manure excreted,	284.81	39.67	44.40	70.15	119.25	11.34
Amount digested,	517.02	23.19	73.07	132.92	258.88	28.95
Minus hay digested,	369.49	19.82	43.75	122.23	174.86	8.88
Bibby's dairy cake digested,	147.53	3.37	29.32	10.69	84.02	20.07
Per cent. digested,	65.71	17.92	61.06	51.82	74.23	84.19
Average per cent. three sheep digested,	69.23	29.42	66.24	60.13	77.84	89.75

Period XXVIII. (1903).

Old Sheep I.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
600 grams hay,	529.50	40.40	63.70	167.32	242.99	15.09
300 grams hominy meal,	265.44	8.97	32.46	13.19	184.29	26.52
Total consumed,	794.94	49.37	96.16	180.51	427.28	41.61
287.33 grams manure excreted,	267.16	30.22	35.83	76.11	115.76	9.24
Amount digested,	527.78	19.15	60.33	104.40	311.52	32.37
Minus hay digested,	338.88	18.18	40.13	112.10	160.37	8.15
Hominy meal digested,	188.90	.97	20.20	-	151.15	24.22
Per cent. digested,	71.16	10.81	62.23	-	82.02	91.33

Old Sheep II.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Total consumed as above,	794.94	49.37	96.16	180.51	427.28	41.61
262.46 grams manure excreted,	242.88	31.36	34.54	63.12	104.95	8.91
Amount digested,	552.06	18.01	61.62	117.39	322.33	32.70
Minus hay digested,	338.88	18.18	40.13	112.10	160.37	8.15
Hominy meal digested,	213.18	-	21.49	5.29	161.96	24.55
Per cent. digested,	80.31	-	66.20	40.11	87.88	92.57

Old Sheep III.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Total consumed as above,	794.94	49.37	96.16	180.51	427.28	41.61
231.44 grams manure excreted,	215.03	28.08	32.00	51.74	93.34	9.87
Amount digested,	579.91	21.29	64.16	128.77	333.94	31.74
Minus hay digested,	338.88	18.18	40.13	112.10	160.37	8.15
Hominy meal digested,	241.03	3.11	24.03	16.67	173.57	23.59
Per cent. digested,	90.80	34.67	74.03	126.38	94.18	88.95
Average per cent. three sheep digested,	**80.76**	**22.74**	**67.49**	-	**88.03**	**90.95**

Summary of Coefficients (Per Cent.).

RATION.	Sheep Number.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Soy bean fodder,	Old Sheep I.,	63.56	26.29	84.35	39.74	76.09	66.33
	Old Sheep II.,	62.51	16.89	82.12	30.83	79.45	66.00
	Old Sheep III.,	64.53	19.97	82.41	46.13	77.92	63.93
Average,	. . . .	**63.53**	**21.05**	**82.96**	**38.90**	**77.82**	**65.42**
Eureka silage corn fodder (green).	Old Sheep I.,	64.32	43.10	66.50	56.17	70.26	67.32
	Old Sheep II.,	68.57	41.76	66.85	63.65	74.35	65.68
	Old Sheep III.,	66.99	41.76	67.70	60.97	72.72	64.80
Average,	. . . .	**66.63**	**42.21**	**67.02**	**60.26**	**72.44**	**65.93**
Eureka silage corn fodder (dry).	Old Sheep II.,	63.88	39.66	57.72	71.09	64.14	62.72
	Old Sheep III.,	63.80	41.02	56.36	72.02	63.50	62.14
Average,	. . . .	**63.84**	**40.34**	**57.04**	**71.56**	**63.82**	**62.43**
Apple pomace,	Old Sheep I.,	67.39	42.23	-	55.43	82.73	44.21
	Old Sheep II.,	73.64	62.64	-	68.94	85.65	43.50
	Old Sheep III.,	70.77	23.55	-	77.57	84.53	42.51
Average,	. . . .	**70.60**	**42.81**	-	**67.31**	**84.30**	**43.41**
English hay,	Young Sheep I.,	48.16	11.40	34.59	48.93	54.63	28.42
	Young Sheep II.,	53.22	23.34	36.93	55.34	58.17	37.09
	Young Sheep III.,	51.53	16.55	36.66	53.13	57.02	36.97
Average,	. . . .	**50.97**	**17.10**	**36.06**	**52.47**	**56.61**	**34.16**
English hay,	Young Sheep I.,	51.61	16.31	40.14	51.03	57.95	48.66
	Young Sheep II.,	55.46	21.85	38.50	56.35	61.36	51.29
Average,	. . . .	**53.54**	**19.08**	**39.32**	**53.69**	**59.66**	**49.98**
English hay,	Old Sheep II.,	56.91	20.06	41.86	58.28	62.68	47.05
	Old Sheep III.,	60.41	24.25	42.85	63.45	65.60	45.69
Average,	. . . .	**58.66**	**22.16**	**42.36**	**60.87**	**64.14**	**46.37**
Bibby's dairy cake,	Young Sheep I.,	77.76	44.16	68.11	63.07	87.79	94.91
	Young Sheep II.,	64.78	37.19	58.41	1.27	79.50	91.56
	Young Sheep III.,	69.51	28.56	67.82	-	86.15	98.88
Bibby's dairy cake (1903),	Old Sheep I.,	61.40	27.16	61.95	-	71.29	90.02
	Old Sheep II.,	80.59	43.17	75.72	68.44	88.01	95.05
	Old Sheep III.,	65.71	17.92	61.06	51.82	74.23	84.19
Average,	. . . .	**69.96**	**33.03**	**65.51**	**46.15**	**81.16**	**92.44**
Alma dried molasses-beet-pulp.	Old Sheep II.,	86.98	68.54	69.00	84.47	93.47	-
	Old Sheep III.,	82.04	54.50	59.15	83.27	88.68	-
Average,	. . . . .	**84.51**	**61.52**	**64.08**	**83.87**	**91.08**	-
Armour's blood meal,	Young Sheep I.,	100.+	-	88.41	-	-	-
	Young Sheep II.,	90.33	-	79.58	-	-	-
Average,	. . . . .	-	-	**84.00**	-	-	-
Medium green soy bean meal.	Old Sheep II.,	98.43	76.83	95.35	122.20	103.20	96.89
	Old Sheep III.,	81.01	62.39	87.68	104.90	61.28	89.37
Average,	. . . . .	**89.72**	**69.61**	**91.51**	**113.55**	**82.24**	**93.13**

Summary of Coefficients (Per Cent.) — Concluded.

Ration.	Sheep Number.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Marshall hominy feed, .	Young Sheep I.,	85.87	53.95	58.19	74.25	91.63	93.19
	Young Sheep II.,	77.75	30.56	54.20	1.99	87.16	94.88
	Young Sheep III.,	74.65	30.27	61.84	-	84.21	94.22
Hominy meal (1903), .	Old Sheep I., .	71.16	10.81	62.23	-	82.02	91.33
	Old Sheep II., .	80.31	-	66.20	40.11	87.88	92.57
	Old Sheep III., .	90.80	34.67	74.03	126.38	94.18	88.95
Average, ...	. . . . .	**80.09**	**32.05**	**62.78**	**60.68**	**87.86**	**92.52**

The Results discussed.

The more important results obtained from the several digestion experiments, the details of which are reported in the previous tables, are discussed as follows: —

Soy Bean Fodder (Brooks Medium Green). — The yield of fodder was light (about 6 tons to the acre), due to the cool summer of 1903. The plants were quite green, thickly set with leaves, well podded and the seed fairly well developed. In common with other legumes at a similar stage of growth, the fodder showed a noticeably high protein percentage, and only moderate quantities of fiber and extract matter. The three sheep ate the fodder readily and digested it quite evenly. Sheep II. refused small quantities of the coarse stems. The results agree fairly well with those already on record.[1]

Summary of Experiment (Per Cent.).

	Number of Different Lots.	Single Trials.	Dry Matter.	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
Sheep I., ...	1	1	63.56	26.29	84.35	39.74	76.09	66.33
Sheep II., ...	1	1	62.51	16.89	82.12	30.83	79.45	66.00
Sheep III., ...	1	1	64.53	19.97	82.41	46.13	77.92	63.98
Average, ...	1	3	63.53	21.05	82.96	38.90	77.82	65.42
Average, previous experiments,	5	12	[2]65.00	-	75.00	46.00	75.00	48.00
Clover for comparison, . . .	3	7	66.00	-	70.00	54.00	72.00	64.00
Cow peas for comparison, . .	2	4	[2]68.00	23.00	76.00	60.00	81.00	59.00

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[1] See especially Phelps' work in the reports of the Storrs Experiment Station for 1896 and 1898, and the summary reported in Lindsey's compilation, fourteenth report of the Hatch Experiment Station, p. 198.

[2] Organic matter.

The total dry matter of the soy bean fodder appears to be slightly less digestible than that of other legumes, — clover, Canada field peas and cow peas, — due to its characteristic hard, woody stems. Attention is called to the fact that the digestion coefficient of the fiber in the soy beans is relatively low (39 and 46 per cent.), as compared with those for the clover and cow peas (54 and 60 per cent.). Soy beans will find their chief use in the farm economy as a soiling and silage crop. This subject will be discussed more fully at a later date.

Eureka Silage Corn. — This was a large southern dent variety, 12 to 13 feet tall, which is held in high esteem for silage purposes by the farmers of Worcester County. It is claimed that it will produce several matured ears to each stalk under average summer conditions. The season of 1903 was noticeably cool, and when the corn was cut, September 12–18, it was quite green, the kernels just forming. This variety is being further studied during the present season (1904), and its value as compared with the smaller varieties will be discussed in a subsequent report.

The three sheep showed only slight variations in their ability to digest the corn. The following figures show the average results of all trials with immature dent varieties, as compared with Eureka. The results are quite similar, except that the fiber in case of the Eureka showed a slightly lower digestibility.

Summary of Experiment (Per Cent.).

	Number of Different Lots.	Single Trials.	Dry Matter.	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
Dent corn fodder, immature, . .	4	11	68.00	-	66.00	67.00	71.00	68.00
Eureka (present trial), . . .	1	3	67.00	42.00	67.00	60.00	72.00	66.00

Apple Pomace. — In the sixteenth report of this station (pp. 63–80) are given the results of a digestion test with apple pomace. In that experiment the pomace was fed with a reasonable quantity of hay. In the present trial a smaller amount of hay was fed, and in addition each sheep was given 150 grams of cotton-seed meal, in the hope of increasing the digestibility of the protein in apple pomace.[1] For the sake of comparison, the coefficients obtained in both experiments follow : —

Summary of Experiment (Per Cent.).

	Dry Matter.	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
Former Experiment, Hay and Pomace.						
Sheep I.,	67.29	42.23	-	55.48	82.73	44.21
Sheep II.,	73.64	62.64	-	68.94	85.65	43.50
Sheep III.,	70.77	23.55	-	77.57	84.53	42.51
Average,	70.60	42.81	-	67.31	84.30	43.41
Present Experiment, Hay, Cotton-seed Meal and Pomace.						
Sheep I.,	65.63	60.91	-	35.82	80.31	51.99
Sheep II.,	71.83	47.20	-	63.93	83.59	39.10
Sheep III.,	80.06	56.11	-	84.95	89.53	50.56
Average,	72.51	54.74	-	61.57	84.48	47.22
Average, both trials,	71.50	48.70	-	64.40	84.40	45.30

Both experiments were made with the same lot of sheep. The sheep digested the total dry matter of the pomace rather more evenly in the present than in the former trial. It is evident that Sheep I. was unable to utilize as much as the other two sheep. It will be seen that the fiber, extract matter and fat, comprising the larger part of the dry matter of the pomace, were digested to approximately the same degree in both experiments. The protein content of the pomace is small, about 1 per cent., and it has not been possible by present methods to fix its digestibility. It probably is digested to a considerable degree, although the results do not make it apparent. The several experiments show the pomace to be as digestible as the better grades of corn silage. Its value for feeding purposes will be further discussed under a separate heading.

English Hay. — The hay used in the present series consisted of a mixture of timothy and redtop, cut in late bloom, and well cured. Two different analyses of this hay are reported in the table of composition. It contained rather less protein and more fiber than the hay usually employed by us for digestion experiments.

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[1] In determining the digestibility of the apple pomace, average digestion coefficients were taken for the cotton-seed meal. See fourteenth report of this station, p. 209.

The young sheep (Period IV.) did not digest the hay as fully as did the old sheep (Period V.) The experiment was repeated with two of the young sheep in Period XII., in which case higher coefficients were obtained, though they did not equal those secured with the old sheep. The hay showed a fair digestibility, and no extreme variations were noted among the several sheep in the same trial. The results, however, do not agree as closely as most of the former experiments with hay carried out at this station.

Bibby's Dairy Cake, made by J. Bibby & Sons of Liverpool, Eng., is composed principally of ground cotton-seed, cereals such as barley and wheat, molasses, fenugreek and salt. It has a pleasing taste and smell, and appears to be highly relished by farm animals. The results of two distinct trials are reported, the first made during the winter of 1903 with three old sheep, and the second made during the winter of 1904 with three young sheep. The first sample was purchased from the stock of a retail grain dealer, and the second was obtained directly from a recent importation. Both lots were in good condition, and resembled each other closely in chemical composition. In the second trial the cake was not relished by Sheep III., although he was induced to eat it after a few days. The cake, which was ground before being fed, acted as a laxative, at first producing soft fæces, which gradually hardened as the period advanced.

Summary of Experiment (Per Cent.).

	Dry Matter.	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
Sheep I., old, . . .	61.40	27.16	61.95	-	71.29	90.02
Sheep II., old, . . .	80.59	43.17	75.72	68.44	88.01	95.06
Sheep III., old, . . .	65.71	17.92	61.06	51.82	74.23	84.19
Average, three sheep,	69.23	29.42	66.24	60.13	77.84	89.75
Sheep I., young, . .	77.76	44.16	68.11	63.07	87.79	94.91
Sheep II., young, . .	64.78	37.19	58.41	1.27	79.50	91.56
Sheep III., young, . .	69.51	28.56	67.82	-	86.15	98.88
Average, three sheep,	70.68	36.63	64.78	32.17	84.14	95.11
Average, six sheep, .	69.95	33.02	65.51	46.15	80.99	92.43

Especially wide variations are noted in the case of the old sheep. Sheep II. seemed to have a strong digestion, while Sheep I., judging from the results, was slightly out of condition. Such extreme variations are not apparent in case of the young sheep. In both experiments considerable difficulty was experienced in digesting the crude fiber, due probably to the fact that it was derived largely from cottonseed hulls. The protein was moderately digestible, while the extract matter and fat yielded fairly high coefficients. In general it may be said that the dairy cake was only moderately digested, and possessed a nutritive value similar to standard wheat middlings. An experiment with Bibby's cake fed to four dairy cows has been completed, and the relative commercial and nutritive value of this concentrate will be more fully discussed in that connection.

Dried Molasses-beet-pulp. — This material, manufactured by the Alma Sugar Company of Alma, Mich., consisted of beet pulp and crude molasses dried.[1] In appearance it resembled ordinary black tea. The analysis showed it to be low in protein and high in fiber and extract matter; only traces of fat were found. A more detailed analysis of the product showed that the crude protein consisted of 7.01 per cent. of true albuminoids and 2.90 per cent. of amides; the extract matter contained 13.80 per cent. of cane sugar and 1.83 per cent. of dextrose. The pentosans (18.40 per cent.) were in all probability largely in the form of a hemi-cellulose, and would also be included in the extract matter. The above figures are based on the material in its natural state, with 8.58 per cent. moisture. The results of the experiment with two old sheep follow: —

Summary of Experiment (Per Cent.).

	Dry Matter.	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
Sheep II., ...	86.98	68.54	69.00	84.47	93.47	-
Sheep III., ...	82.04	54.50	59.15	83.27	88.68	-
Average, . . .	84.51	61.52	64.08	83.87	91.08	-
Corn meal for comparison,	89.00	-	70.00	-	94.00	91.00

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[1] See Bulletin No. 99 for a description of the process and a full discussion of its value.

The sheep ate the material readily and digested it without trouble. From the high average digestibility and an experiment with dairy animals elsewhere reported,[1] it is believed the dried pulp has a feeding value about 10 per cent. less than corn meal.

Armour's Blood Meal, especially prepared for cattle feeding, was found to contain 95.24 per cent. of protein and only traces of fat and fiber. Its mechanical condition was all that could be desired. As the detailed experiment shows, it was fed to two young sheep in combination with hay and corn meal. In figuring the digestibility of the blood the coefficients for the corn meal were taken from Lindsey's compilation.[1] The two sheep digested the dry matter of the blood quite thoroughly, namely, 95.14 per cent. The protein was not as thoroughly digested, — 83.99 per cent.; but this must be more apparent than real, and due to the influence of the other constituents. It is probable that the protein of the hay and corn meal was not quite as thoroughly digested as the coefficients call for, leaving a slight excess undigested, which must of necessity be charged against the blood. This supposition is strengthened by the fact that there is a small plus balance of extract matter and a minus balance of fiber, which show digestible divergences from the established hay and corn meal coefficients. Judging from the digestibility of the dry matter of the blood, we may safely conclude that the blood protein must be quite thoroughly utilized by farm animals. An experiment with dried blood as a source of protein for dairy animals has been completed, and its economic value will be discussed when the results of that experiment are published.

Soy Bean Meal (Brooks Medium Green). — The beans were grown at the station, and coarsely ground before being fed. They were of the usual good quality, containing 40.69 per cent. of protein and 21.10 per cent. fat in dry matter. The coefficients obtained in 1903 follow, and also those secured in the present trial: —

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[1] *Loco citato.*

Summary of Experiment (Per Cent.).

	Dry Matter.	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
Sheep II., old, 1903,	95.46	44.93	92.80	194.62	93.04	95.67
Sheep III., old, 1903,	87.32	41.70	89.34	85.43	89.29	91.34
Average,	91.39	43.32	91.07	140.03	91.17	93.51
Sheep II., old, 1904,	98.43	76.83	95.35	122.20	103.20	96.51
Sheep III., old, 1904,	81.01	62.39	87.68	104.90	61.28	89.37
Average,	89.72	69.61	91.51	113.55	82.24	92.94
Average, four trials,	90.56	56.47	91.29	126.79	86.71	93.23
Average, two German trials for comparison,	[1]85.00	-	87.00	-	62.00	94.00

[1] Organic matter.

The soy bean, in common with other concentrates rich in nitrogen, frequently causes digestive irregularities. In the present trial Sheep III. was not able to digest the feed as thoroughly as Sheep II. The same condition was apparent last year, although not quite as marked. It is evident that the beans are as a rule quite thoroughly digested, especially the protein and fat, which are the two important constituents. The coefficients for the fiber are, of course, incorrect, due probably to the favorable influence of the rich protein concentrate in increasing the digestibility of the hay carbohydrates. The small amount of fiber present — about 5 per cent. — renders a knowledge of the exact percentage digestible of minor importance. The extract matter was also largely digested, — probably 80 or more per cent., — although the trials made thus far have not given sufficiently definite results to enable one to fix any exact coefficient.

Hominy Feed, or Chop. — As used for cattle feeding, this consists of the hull, germ, some of the gluten and soft starch. The two samples tested were of good average quality. The results of six trials are presented. Three of them were made with old sheep in 1903, and three with young sheep in 1904.

Summary of Experiment (Per Cent.).

	Dry Matter.	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
Sheep I., old, 1903, . . .	71.16	10.81	62.23	-	82.02	91.33
Sheep II., old, 1903, . . .	80.31	-	66.20	40.11	87.88	92.57
Sheep III., old, 1903, . . .	90.80	34.67	74.03	126.50	88.03	90.95
Average, ...	80.75	22.74	67.48	-	85.97	91.61
Sheep I., young, 1904, . .	85.87	53.95	58.19	74.25	91.63	93.19
Sheep II., young, 1904, . .	77.75	30.56	54.20	1.99	87.16	94.88
Sheep III., young, 1904, . .	74.65	30.27	61.84	-	84.24	94.22
Average, ...	79.42	38.26	58.07	38.12	87.66	94.09
Average, both experiments,	80.08	30.50	62.77	-	86.81	92.85
Corn meal for comparison, .	89.00	-	70.00	-	94.00	91.60

In the first trial Sheep I. evidently had a somewhat weakened digestion. This condition has already been referred to, and this sheep was dropped during 1904. Sheep III. appeared to have digested the hominy quite thoroughly, while Sheep II. gave results midway between the other two. Just why the three sheep should have shown such variable results with a feed that is supposed to be easily digested, is not clear. In the second trial, with a different sample and with the young sheep, the results also vary more than one would expect. Sheep III. was unable to digest the starchy matter as well as the other two, but made better use of the protein. The percentage of fiber contained in the hominy is relatively small, and the results differ so noticeably that they must be considered worthless. Both lots of sheep utilized the starchy matter and fat to about the same degree; the young sheep failed to digest the protein, as well as the old sheep. The average results of the two experiments must be regarded as giving a fairly good idea of the digestibility of the several fodder groups. It has been assumed hitherto that hominy was as digestible as corn meal; but, in view of the results obtained, this opinion is no longer tenable. The total dry matter of the hominy seems to be about 9 per cent. less digestible than that of the corn. This deficiency apparently falls largely on the protein and extract matter. Corn meal as found upon the market contains on an average 14 per cent. of water, or 1,720 pounds of dry matter to the ton; while hominy shows 9 per cent. of water, or 1,820 pounds of dry matter to the ton. Applying the digestion coefficients for dry matter obtained in both cases, hominy would yield 1,456 pounds and corn meal 1,531 to the ton, and would show the corn meal to be about 5 per cent. more valuable than the hominy. It is proposed to repeat the digestion test with still another sample, and also to compare the two feeds with milch cows. The fact must not be overlooked that different samples of both grains, more particularly the hominy, are likely to vary somewhat in nutritive value, hence too positive conclusions should not be drawn. On the basis of our present knowledge, it may be said that both feeds have similar nutritive values.

Eureka Silage Corn Fodder. — This was a cured sample of the variety previously described. In composition it differed somewhat from the green sample, by containing more ash, noticeably more fiber and less extract matter. Whether this change was the result of sampling, or whether it was brought about by the curing process, it is difficult to say. In case of the green corn, small lots were cut every two or three days during the experiment, each lot being carefully sampled and moisture determinations made immediately. At the end of the trial equal weights of each sample were mixed, and this mixture held to represent the corn fed during the entire experiment. To secure as fair a sample as possible of the material to be cured, a considerable quantity was cut about the middle of the digestion trial with the green corn, and placed in stooks in the field. The stooks were removed to the barn before snow came. In spite of the care taken, differences in the composition of the two lots would be likely to occur. At the time of feeding the cured material, in early March, it still contained 60 per cent. of water. It was finely cut before feeding, and, though somewhat mouldy on the outside, proved to be in fairly good condition. Because of the unexpected large water content, the sheep did not receive a sufficient amount daily, — 1,200 grams, — although the results show that they suffered no great loss in live weight during the period. Sheep III. ate the ration clean, while Sheep II. refused a noticeable amount of the coarser portions. The following figures show the results with the dry fodder; for comparison, the results obtained with the green corn are also stated: —

Summary of Experiment (Per Cent.).

	Dry Matter.	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
Sheep II., old, dry fodder, .	63.88	39.66	57.72	71.09	64.14	62.72
Sheep III., old, dry fodder, .	63.80	41.02	56.36	72.02	63.50	62.14
Average, ...	63.84	40.34	57.04	71.56	63.82	62.43
Sheep I., old, green fodder, .	64.32	43.10	66.50	56.17	70.26	67.32
Sheep II., old, green fodder, .	68.57	41.76	66.85	63.65	74.34	65.68
Sheep III., old, green fodder, .	66.99	41.76	67.70	60.97	72.72	64.80
Average, ...	66.63	42.21	67.02	60.26	72.44	65.93

The coefficients obtained are concordant, and the experiment may be considered quite satisfactory. In comparing the results of the two experiments, it will be noticed that the dry fodder was not as well digested as the green material. This may be accounted for partly on the ground that the sheep received the green fodder in September, after having been at pasture all summer, while the dried material was fed in March, after they had been in similar experiments for six months; and partly because previous experiments have demonstrated that in case of very coarse fodders sheep digest the green substance a little more thoroughly than the cured. For some reason the fiber in the dry material was more fully digested than in the green substance. This may be due to the fact that in the cured fodder some of the extract matter had been converted into a hemi-cellulose, which resisted the action of the chemical solvents, but yielded to the influence of the digestive fluids. In general, it may be said that the results obtained with the Eureka corn compare very favorably with those obtained by other experimenters with the southern varieties at a similar stage of growth.

2. THE DIGESTIBILITY OF GALACTAN.

REPORTED BY J. B. LINDSEY.[1]

Those carbohydrates that can be removed from plants and seeds by the action of dilute mineral acid and alkali, and that are soluble in F. Schulze's reagent, E. Schulze has termed hemi-celluloses. Under this heading he has brought the mother substances, — dextran, levulan, mannan, galactan, araban and xylan; which yield on inversion the sugars, — dextrose, levulose, mannose, galactose, arabinose and xylose. These hemi-celluloses are intermixed with the true celluloses in the cell walls of the plants and seeds. They have been frequently recognized as reserve material, being used by the embryo during the sprouting of the seed. The levulan and mannan have not been found generally distributed, while the araban and xylan (pentosans) constitute fully one-third of the extract matter of all hays and straws, are quite prominent in the hull and bran of most grain seeds, and are even found in the endosperm and cotyledons of many seeds.

Galactan was first extracted from lucerne seeds by Muntz,[2] and was converted into galactose by boiling with dilute acid. E. Schulze[3] and his co-workers found considerable galactan in the seeds of the blue lupine, and as a result assumed that this hemi-cellulose might be very generally distributed in agricultural plants. Lindsey and Holland[4] determined the percentage of galactan in a large number of hays, straws and concentrated feeds. The results of their work showed the presence of quite small amounts of galactan in the non-leguminous plants and seeds. In the leguminous plants from 3 to 4 per cent. was found, while in leguminous seeds the amount varied from 1½ to 14 per cent.

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[1] This experiment was carried out by Mr. E. S. Fulton of the class of 1904 of the Massachusetts Agricultural College, who expressed a desire to undertake work of this character for a graduation thesis. The sheep and apparatus belonging to the department of foods and feeding were placed at his disposal. The digestibility of the hay used had already been determined. Mr. Fulton assumed charge of the sheep, and prepared the fæces for analysis in the station laboratory. The analytical work was done at the college laboratory, under the supervision of Prof. C. Wellington. Mr. Fulton expresses his thanks to Professor Wellington and also to Dr. Lindsey and his co-workers for the many helps and suggestions received.

[2] Bul. Soc. Chem. (2), 37, p. 409.

[3] Zeitsch. f. physiol. Chem. Bd. 14, Heft. 3, Zeitsch. f. physiol. Chem. Bd. 16, Hefts. 4 and 5.

[4] Ninth report of the Hatch Experiment Station, pp. 92-96.

The method[1] employed was the one proposed by Tollens and his pupils, and consisted in principle of oxidizing a given amount of the plant or seed with a solution of slightly diluted nitric acid, and collecting the resulting mucic acid, after further treatment for the removal of impurities, on a tared filter.

No experiments are on record relative to the digestibility of galactan, hence the undertaking of this trial. Alsike clover seed was selected because it contained a noticeable quantity of galactan. It was ground reasonably fine, and fed in connection with hay, the digestibility of which had been previously determined. The experiment was conducted in the usual way, three young Southdown wethers being employed, and passed off without any disturbances.

TABULATED DATA OF THE EXPERIMENT.

Composition of Feed Stuffs (Per Cent.).

[Dry matter.]

FEEDS.	Galactan.	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
Hay,[2]	1.72	6.53	6.23	33.00	52.27	1.97
Clover seed, . . .	8.07	5.88	34.29	13.12	41.42	5.29

Composition of Fæces (Per Cent.).

[Dry matter.]

Sheep.	FEEDS.	Galactan.	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
I., .	Hay and clover seed,	.99	11.57	11.97	29.27	44.43	2.76
II., .	Hay and clover seed,	.95	11.21	13.11	30.23	42.84	2.61
III., .	Hay and clover seed,	1.02	11.32	12.63	28.94	44.49	2.62
I., .	Hay,[2]	.86	11.16	7.86	32.51	45.75	2.72
II., .	Hay, ...	.76	10.70	8.40	31.51	46.74	2.65
III., .	Hay, ...	1.07	10.92	7.97	32.20	46.40	2.51

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[1] *Loco citato.*

[2] The figures for all constituents, excepting galactan, in hay and hay manures were determined in a previous experiment.

Dry Matter Determinations made at the Time of weighing out the Foods, and Dry Matter in Manure excreted, estimated from Air-dry Fæces (Per Cent.).

Sheep.	Feeds.	Hay.	Clover Seed.	Manure.
I., . .	Hay and clover seed, ...	88.85	91.53	94.05
II., . .	Hay and clover seed, ...	-	-	93.70
III., . .	Hay and clover seed, ...	-	-	94.07
I., . .	Hay, ...	-	-	93.36
II., . .	Hay, ...	-	-	93.27
III., . .	Hay, ...	-	-	93.25

Table showing Food fed, Water drank daily, and Daily Amount of Manure excreted.

[Food consumed daily: 600 grams hay, 200 grams clover seed, 5 grams salt.]

DATE.	SHEEP I.			SHEEP II.			SHEEP III.		
	Manure excreted daily (Grams).	Sample Air Dry (Grams).	Water drank daily (Cubic Centimeters).	Manure excreted daily (Grams).	Sample Air Dry (Grams).	Water drank daily (Cubic Centimeters).	Manure excreted daily (Grams).	Sample Air Dry (Grams).	Water drank daily (Cubic Centimeters).
March 20,	922.0	33.24	1,590.0	741.0	29.29	2,290.0	663.0	24.66	2,415.0
" 21,	853.0	29.16	1,060.0	888.0	31.98	1,865.0	879.0	31.60	2,410.0
" 22,	829.0	30.11	1,615.0	938.0	28.55	2,500.0	988.0	33.29	2,425.0
" 23,	799.0	29.56	1,350.0	1,059.0	32.02	2,500.0	822.0	32.29	2,400.0
" 24,	738.0	27.60	1,855.0	852.0	28.14	2,500.0	973.0	33.39	2,500.0
" 25,	909.0	31.64	1,950.0	949.0	29.02	2,500.0	964.0	33.93	2,500.0
" 26,	927.0	33.69	1,750.0	1,316.0	33.50	2,500.0	1,050.0	36.21	2,500.0
Average,	853.9	30.71	1,595.7	963.3	30.36	2,379.3	878.4	32.19	2,450.0

	Pounds.
Weight of Sheep I. at beginning of period,	99.25
Weight of Sheep II. at beginning of period,	94.75
Weight of Sheep III. at beginning of period,	91.50
Weight of Sheep I. at end of period,	99.50
Weight of Sheep II. at end of period,	94.00
Weight of Sheep III. at end of period,	91.00

Sheep I.

	Dry Matter (Per Cent.).	Galactan (Per Cent.).	Ash (Per Cent.).	Protein (Per Cent.).	Fiber (Per Cent.).	Nitrogen-free Extract (Per Cent.).	Fat (Per (Cent.).
600 grams hay fed, ...	533.10	9.17	34.81	33.21	175.92	278.65	10.50
200 grams clover seed, ...	183.06	14.77	10.76	62.77	24.02	75.82	9.68
Total consumed, ...	716.16	23.94	45.57	95.98	199.94	354.47	20.18
307.10 grams manure excreted, . . .	288.83	2.86	33.42	34.57	84.54	128.33	7.97
Grams digested, ...	427.33	21.08	12.15	61.41	115.40	226.14	12.21
Minus hay digested,[1]	265.95	6.90	4.82	12.41	87.93	156.85	4.05
Clover seed digested, ...	161.38	14.18	7.33	49.00	27.47	69.29	8.16
Per cent. digested, ...	88.16	96.01	68.12	78.06	114.36	91.39	84.30

Sheep II.

600 grams hay fed, ...	533.10	9.17	34.31	33.21	175.92	278.65	10.50
200 grams clover seed, ...	183.06	14.77	10.76	62.77	24.02	75.82	9.68
Total consumed, ...	716.16	23.94	45.57	95.98	199.94	354.47	20.18
303.60 grams manure excreted, . . .	284.47	2.70	34.03	37.29	86.00	121.87	7.42
Grams digested, ...	431.69	21.24	11.54	58.69	113.94	232.60	12.76
Minus hay digested,[2]	289.69	7.28	7.87	12.53	98.25	166.55	4.64
Clover seed digested, ...	142.00	13.96	3.67	46.16	15.69	66.05	8.12
Per cent. digested, ...	77.57	94.52	34.11	73.54	65.32	87.11	83.88

Sheep III.

600 grams hay fed, ...	533.10	9.17	34.81	33.21	175.92	278.65	10.50
200 grams clover seed, ...	183.06	14.77	10.76	62.77	24.02	75.82	9.68
Total consumed, ...	716.16	23.94	45.57	95.98	199.94	354.47	20.18
321.90 grams manure excreted, . . .	302.81	3.09	34.28	38.24	87.63	134.72	7.93
Grams digested,[3]	413.35	20.85	11.29	57.74	112.31	219.75	12.25
Minus hay digested, ...	274.71	6.55	5.76	12.17	93.47	158.89	3.88
Clover seed digested, ...	138.64	14.30	5.53	45.57	18.84	60.86	8.37
Per cent. digested, ...	75.74	96.82	51.39	72.60	78.43	80.27	86.47

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[1] Used average coefficient of Sheep I., Periods IV. and XII.

[2] Used average coefficient of Sheep II., Periods IV. and XII.

[3] Used coefficients of Sheep III., Period IV.

SUMMARY OF THE RESULTS.

Composition of the Feeds (Per Cent.).

	Galactan.[1]	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
Hay, ...	1.72	6.53	6.23	33.00	52.27	1.97
Clover seed, . . .	3.07	5.88	34.29	13.12	41.42	5.29

Digestibility of the Feeds (Per Cent.).

	Dry Matter.	Galactan.	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
Hay (all sheep), . .	53.50	75.85	20.50	37.00	55.00	59.00	42.00
Clover seed, Sheep I.,	88.16	96.01	68.12	78.06	114.86	91.39	84.30
Clover seed, Sheep II.,	77.57	94.52	34.11	73.54	65.83	87.11	82.88
Clover seed, Sheep III.,	75.74	96.82	51.39	72.60	78.43	80.27	86.47
Average, . . .	80.49	95.78	51.21	74.73	86.04	86.26	84.55

The analysis and digestibility of the hay were made in connection with a series of digestion experiments at the station. It appeared to contain rather more galactan than other samples examined.[2]

A previous complete analysis of alsike clover seed does not appear to be recorded. It contained a high percentage of protein and a normal amount of galactan.

The results of the digestion experiment with the three sheep show the *total dry matter* of the clover seed meal to have been fairly well digested, although the coefficients are noticeably lower than those on record for soy beans, peas, vetch and lupine (85 to 90 per cent.).

The galactan in the hay is shown to be 75 per cent. digestible. Because of the small quantity present, the results are of minor importance. All three sheep digested the galactan in the clover seed quite thoroughly. Such a result was to have been expected, for the reason that in the seed the galactan is supposed to be comparatively free from in-crusting substances, which have been shown by various investigators to seriously interfere with the digestibility of the several fodder groups.[1] Naturally, no positive conclusions should be drawn from the present single investigation. Knowing, however, the physiological and chemical character of the galactan, as well as the digestion coefficients obtained with starch and with the pentosans, — bodies of similar character, — it is reasonably safe to conclude that the results secured give a fairly correct idea of the ability of the animal to utilize the galactan group.

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[1] It may be assumed that the galactan belongs almost wholly to the nitrogen-free extract matter.

[2] Whether the substance obtained was pure galactan, or consisted partly of impurities that it was not possible to remove, it is difficult to say. Lindsey and Holland found a trifle less than 1 per cent. in another sample.

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[1] The pentosans, fifteenth report of the Hatch Experiment Station, p. 118.

3. THE FEEDING VALUE OF APPLE POMACE.

BY J. B. LINDSEY.

There is often considerable discussion in the agricultural press and among farmers concerning the value of apple pomace as a food for dairy and beef cattle; with a view to getting a little positive data, this station instituted a number of experiments, the results of which are here briefly stated.

(a) *Composition of Apple Pomace (Per Cent.).*

	Water.	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
Sample I., ...	81.40	.73	.94	3.00	13.03	.90
Sample II., ...	80.20	.60	1.01	3.19	13.73	1.27
Corn silage for comparison,	80.00	1.10	1.70	5.40	11.10	.70

It will be seen from the above figures that apple pomace is a carbohydrate feed similar to corn silage. It contains about the same amount of water (four-fifths), rather less protein and fiber, and a larger proportion of extract matter. Whether the extract matter in the pomace is as valuable, pound for pound, as that contained in the corn, has not been thoroughly demonstrated.

(b) *Digestibility of Apple Pomace.*

The value of a feed cannot always be measured by its composition. A food is valuable as a source of nutrition only in so far as its various constituents can be digested and assimilated. This station has made two different experiments to ascertain the digestibility of the pomace, and the detailed results are to be found elsewhere in this report. The summary follows: —

Summary of Experiments (Per Cent.).

	Number of Single Trials.	Dry Matter.	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
Apple pomace (first experiment), . .	3	72.5	54.7	-	61.6	84.5	47.2
Apple pomace (second experiment), . .	3	70.6	42.8	-	67.3	84.3	43.4
Average, ...	6	71.5	48.7	-	64.4	84.4	45.3
Dent corn silage (for comparison), . .	17	64.0	-	52.0	62.0	69.0	85.0
Flint corn silage (small varieties), . .	11	75.0	-	65.0	77.0	79.0	82.0

The results show the total dry matter in apple pomace to be about as digestible as in the best grades of silage. The protein content of the pomace is small, — about 1 per cent., — and it has not been possible by present methods to fix its digestibility. Judging from the composition and digestibility of the pomace, one would feel justified in assuming that, pound for pound, it should approach in feeding value an average quality of corn silage.

(*c*) *Experiments with Dairy Animals.*

While this station has not carried out any exhaustive comparative tests with pomace and other coarse feeds, it has fed the pomace a number of seasons to dairy animals. The material was drawn fresh from the mill, and placed in a large pile under cover. A noticeable quantity of juice gradually drained from it, but it kept in good condition for two months. The animals received from 15 to 30 pounds daily, ate it readily, and the results were quite satisfactory. In one case two cows were fed alternately four weeks at a time on grain and hay, and on grain, hay and pomace; 25 pounds of pomace were compared with 5 pounds of hay. During the pomace period the animals produced 1,153 pounds of milk, and gained 24 pounds in live weight; during the hay period, 1,138 pounds of milk, and lost 6 pounds in weight. On this basis, 5 pounds of pomace were more than equivalent to 1 pound of hay. Judging from this feeding test and from the composition and digestibility of the pomace, it seems probable that 4 pounds, when fed in what is termed a "balanced ration," would be equal in feeding value to 1 pound of good cow hay.

The Vermont Experiment Station has fed apple pomace for four years, using in all twenty cows in the several trials. The pomace was shovelled into the silo, levelled off, and kept in good condition without further care. In some cases it was placed on top of the corn silage after the latter had settled. The quantity fed varied from 10 to 35 pounds daily, with no unfavorable effects. As a result of the several experiments, the Vermont station concludes that the pomace is equivalent in feeding value to an equal weight of average corn silage,[1] and that it is without injurious effect on the flavor of milk and butter.

Farmers are cautioned not to feed too large quantities at first, but to begin with 10 pounds daily, and to gradually increase the quantity to 30 pounds, taking a week or more in which to do it. In this way, danger of a sudden milk shrinkage, or of the animals getting "off feed," as is sometimes reported, may be avoided. Judging from all the data available, it is believed that farmers living in the vicinity of cider mills will find it good economy to utilize the pomace as a food for their dairy stock.

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[1] There is doubt in the mind of the writer whether pomace would prove fully equal to well-preserved and well-eared corn silage; it certainly would approach it in feeding value, and ought to be fully utilized.

4. BLOMO FEED FOR HORSES.

J. B. LINDSEY AND P. H. SMITH.

Blomo feed[1] is a mixture of ground corn stalks, or similar material, with dried blood and refuse molasses. It is almost black in color, slightly sticky to handle, and of a bulky, fibrous nature. It has been extensively advertised as a satisfactory partial oat substitute for horses, and is guaranteed to contain 15 per cent. protein and 1.19 per cent. fat. Feeds of similar character have been in use for some time in Europe.

Composition of Blomo Feed (Per Cent.).

	Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Blomo feed,	20.2	9.0	14.7	12.1	43.3	.7
Oats for comparison,	11.0	2.9	12.9	8.5	59.6	5.1
Corn for comparison,	11.0	1.4	10.8	1.9	70.2	4.7

It will be seen from the foregoing table that Blomo feed contains more protein and decidedly less fat and starchy matter than either oats or corn. Part of the extract matter consists of cane sugar derived from molasses. The ash content is considerably in excess of either oats or corn.

Digestibility of Blomo Feed.

A digestion experiment[2] was recently completed at this station, with the following results: —

Digestion Coefficients (Per Cent.).

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Blomo feed,	66.7	31.4	62.7	61.4	76.0	15.3
Oats for comparison,	72.0	33.0	86.0	31.0	79.0	82.0
Corn (cracked) for comparison,	88.0	-	76.0	-	96.0	73.0

[1] Made by the Blomo Manufacturing Company, New York, N. Y.

[2] With sheep.

Digestible Nutrients in a Ton (Pounds).

	Protein.	Fiber.	Nitrogen-free Extract.	Fat.	Total Organic Nutrients.
Blomo feed,	184	149	658	2	993
Oats for comparison,	222	53	942	84	1,301
Corn meal for comparison,	164	-	1,348	69	1,581

It will be seen that the coefficients obtained from the Blomo are noticeably less than those from either corn or oats. The fat coefficient is of minor importance, because of the small quantity present. It is an established fact that horses digest less fiber than sheep, hence the digestion coefficient for the fiber in the Blomo feed, when applied to horses, is probably too high; a coefficient of 50 would be nearer correct.

Applying the digestion coefficients to the composition of the several feeds, and calculating the digestible organic nutrients in 1 ton, it becomes evident that the Blomo contains some 20 per cent. less digestible organic matter than oats, and some 35 per cent. less than corn. This is due to the comparatively undigestible character of the filler employed.

Cost of Digestible Matter in a Ton.

Allowing $32.50 a ton for Blomo ($1.30 an 80-pound bag), $31 a ton for oats (50 cents a bushel of 32 pounds), and $28 a ton for corn meal, the cost of a pound of digestible matter in each of the several feeds would be as follows: —

	Cents.
Blomo,	3.28
Oats,	2.40
Corn meal,	1.77

At the above prices, it will be seen that digestible matter costs nearly twice as much in the form of Blomo feed as when purchased in corn meal, and about one-third more than in the form of oats.

Feeding Trials with Horses.

Four horses belonging to the agricultural division of the station were employed for the purpose. These horses did hard farm work, which naturally varied somewhat in character and amount from time to time.

TRIAL I.

Object. — The object of the trial was to see if the horses would eat Blomo readily, maintain their weight, and keep in as good working condition as when fed their regular ration.

Rations fed. — The ordinary ration, previous to the beginning of the trial, consisted of 6 quarts of oats, 6 quarts of corn, and what hay the animals would eat clean. The trial ration consisted of 6 quarts of Blomo in place of 6 quarts of oats, 6 quarts of corn, and hay. The Blomo and oats should have been compared pound for pound, but through a misunderstanding they were fed quart for quart, so that 4.2 pounds of Blomo were fed against 6 pounds or more of oats.[1] The horses were gradually placed on the Blomo ration. Three ate it readily, while the fourth refused more or less of it at first, but eventually took the entire quantity without objection.

Duration of the Trial. — The trial began March 19 and lasted until July 5. During this time all four horses were kept constantly on the same ration, and in no case did they fail to take the full quantity of Blomo daily.

Weight and Condition of the Horses. — The horses were weighed two mornings weekly before being fed or watered.

Average Weight at Beginning and End of Trial (Pounds).

1904.	No. 1.	No. 2.	No. 3.	No. 4.
March 19,	1,248	1,288	1,368	1,196
July 5,	1,243	1,270	1,358	1,193

The weight varied slightly from week to week, but it is evident that the ration was sufficient to enable the animals to keep in good condition and do the work required.

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[1] Unfortunately, this department did not have the direct care of the animals, hence could not closely supervise the details of the trial.

While the trial was in progress it was found that the Blomo feed, which had been obtained directly from the manufacturers, was several per cent. below its protein guarantee. They claimed that this was due to carelessness on the part of their chemist, and forwarded another lot, with the request that it be used in place of the first shipment.

TRIAL II.

In the second trial the same horses were used.

Object of the Trial. — The object of the trial was to compare the Blomo feed with oats as a partial grain substitute for work horses.

Plan and Duration of the Trial. — The four horses were divided into lots of two each. In the first half of the trial horses Nos. 1 and 4 received the Blomo ration, and horses Nos. 2 and 3 the oat ration. In the second half these conditions were reversed. Each half lasted six weeks, as follows: —

	Blomo Ration.	Oat Ration.	Length (in Weeks).
July 18 through August 28,	Horses Nos. 1 and 4,	Horses Nos. 2 and 3,	6
September 5 through October 17,	Horses Nos. 2 and 3,	Horses Nos. 1 and 4,	6

Character of Rations. — The rations were in all cases measured out by the regular feeder. The same misunderstanding existed as in the former trial regarding the relative weight of the Blomo and oats, the feeder giving equal measure instead of weight of each. This resulted in the comparison of approximately 4.2 pounds of Blomo with 6 pounds of oats, which was manifestly unfair to the Blomo.

Blomo Ration fed daily.	*Oat Ration fed daily.*
6 quarts Blomo feed.	6 quarts oats.
6 quarts cracked corn.	6 quarts cracked corn.
Hay (judgment of feeder).	Hay (judgment of feeder).

Weights of Horses (Pounds).

HORSES.	BLOMO.			OATS.		
	Beginning.	End.	Gain or Loss.	Beginning.	End.	Gain or Loss.
No. 1, . . .	1,230	1,245	15+	1,255	1,240	15—
No. 2, . . .	1,295	1,350	55+	1,265	1,290	25+
No. 3, . . .	1,390	1,370	20—	1,325	1,375	50+
No. 4, . . .	1,180	1,205	25+	1,200	1,195	5—
Totals, . .	5,095	5,170	75+	5,045	5,100	55+

These horses made a slight gain in each case, indicating that both rations were rather more than sufficient to furnish the necessary nutrients for the work performed. Because of the uneven character of the work from day to day, it is not possible to say that one ration gave any better results than the other. It can simply be stated that the horses ate the Blomo ration readily, kept in good condition, and did satisfactory work during the trial.

Keeping Quality of Blomo.

The first lot, of 1 ton, obtained in March, contained 21.5 per cent. of moisture. It was fed gradually until late June, when 480 pounds, or about one-quarter, had spoiled. The second lot, of ½ ton, contained 20 per cent. of water, and was fed from early July until late October, during which time 450 pounds, or nearly one-half, had become sour. This lot underwent a slight decomposition during the warm, muggy weather of August and September. It will be quite necessary for the manufacturers to reduce the moisture content to 12 or less per cent., in order to prevent such changes, especially during the warm season.

Conclusions.

1. Blomo feed was eaten readily, excepting that one of the horses objected to it during the first week of the trial.

2. Considerable of the Blomo spoiled on being kept during the warm weather, and it will be necessary for the manufacturers to reduce the moisture content, in order to overcome this difficulty.

3. It contained noticeably less digestible matter than corn or oats, and, at prices usually prevailing, the nutritive matter it contains must be regarded as decidedly expensive.

4. No injurious effect was noted from feeding a considerable quantity of Blomo as a component of the daily ration during a period of seven months. The horses kept in good condition and did satisfactory work.

5. Owing to a misunderstanding, whereby the Blomo and oats were fed measure for measure, instead of weight for weight, it was not possible to directly compare the feeding value of these two feeds.

6. No particular advantage is to be gained from the use of Blomo feed, other than securing a change from the regular corn and oat diet.

REPORT OF THE CHEMIST.

DIVISION OF FERTILIZERS AND FERTILIZER MATERIALS.

CHARLES A. GOESSMANN.

Assistants: HENRI D. HASKINS, RICHARD H. ROBERTSON,[1] EDWARD G. PROULX.

PART I. — Report on Official Inspection of Commercial Fertilizers.
PART II. — Report on General Work in the Chemical Laboratory.

PART I. — REPORT ON OFFICIAL INSPECTION OF COMMERCIAL FERTILIZERS AND AGRICULTURAL CHEMICALS DURING THE SEASON OF 1904.

CHARLES A. GOESSMANN.

The total number of manufacturers, importers and dealers in commercial fertilizers and agricultural chemicals who have secured licenses during the past season is 66; of these, 38 have offices for the general distribution of their goods in Massachusetts, 8 in New York, 8 in Connecticut, 3 in Vermont, 2 in Pennsylvania, 2 in Ohio, 1 in Rhode Island, 1 in Canada, 1 in New Jersey, 1 in Maryland and 1 in Arkansas.

Three hundred and twenty-nine brands of fertilizers and agricultural chemicals have been licensed in Massachusetts during the year. Five hundred and seventy-six samples of fertilizers have been collected up to the present time, in our general markets by experienced assistants in the station. Five hundred and twenty-five samples were analyzed at the beginning of December, 1904, representing 295 distinct brands of fertilizers. These analyses were published in two bulletins of the Hatch Experiment Station of the Massachusetts Agricultural College: No. 100, July, and No. 102, November, 1904. Other official samples not included in these two bulletins will be reserved for our next publication in March, 1905. By comparing the above statements with those of our previous annual reports, it will be seen that there is a gradual increase in the number of fertilizers that are licensed in the State of Massachusetts from year to year. This fact would tend to show an increased consumption of these articles, and would emphasize the importance of their annual inspection from a commercial agricultural standpoint. Twenty-three more brands of fertilizers have been licensed during the past season than in the previous year.

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[1] Died Sept. 10, 1904.

The following table gives in compact form an abstract of the results of analyses of official commercial fertilizers: —

	1903.	1904.
(*a*) Where three essential elements of plant food were guaranteed: —		
Number with three elements equal to or above the highest guarantee,	7	7
Number with two elements above the highest guarantee, . . .	19	32
Number with one element above the highest guarantee, ...	91	111
Number with three elements between the lowest and highest guarantee,	207	190
Number with two elements between the lowest and highest guarantee,	118	146
Number with one element between the lowest and highest guarantee, .	42	48
Number with three elements below the lowest guarantee, . . .	2	none
Number with two elements below the lowest guarantee, ...	24	12
Number with one element below the lowest guarantee, ...	100	103
(*b*) Where two essential elements of plant food were guaranteed: —		
Number with two elements above the highest guarantee, . . .	2	8
Number with one element above the highest guarantee, ...	17	16
Number with two elements between the lowest and highest guarantee,	31	20
Number with one element between the lowest and highest guarantee, .	13	19
Number with two elements below the lowest guarantee, ...	1	1
Number with one element below the lowest guarantee, ...	14	15
(*c*) Where one essential element of plant food was guaranteed: —		
Number above the highest guarantee, ...	11	16
Number between the lowest and highest guarantee, ...	13	24
Number below the lowest guarantee, ...	18	13

From the above table it will be seen that, on the whole, the quality of the fertilizers that have been licensed, collected and examined during the past year is higher than in the previous season of 1903.

Trade Values of Fertilizing Ingredients in Raw Materials and Chemicals, 1903 and 1904 (Cents per Pound).

	1903.	**1904.**
Nitrogen in ammonia salts,	17.50	17.50
Nitrogen in nitrates,	15.00	16.00
Organic nitrogen in dry and fine-ground fish, meat, blood, and in high-grade mixed fertilizers.	17.00	17.50
Organic nitrogen in fine bone and tankage,	16.50	17.00
Organic nitrogen in medium bone and tankage,	12.00	12.50
Phosphoric acid soluble in water,	4.50	4.50
Phosphoric acid soluble in ammonium citrate,	4.00	4.00
Phosphoric acid in fine-ground fish, bone and tankage,	4.00	4.00
Phosphoric acid in cotton-seed meal, castor pumace and wood ashes,	4.00	4.00
Phosphoric acid in coarse fish, bone and tankage,	3.00	3.00
Phosphoric acid insoluble (in water and ammonium citrate) in mixed fertilizers.	2.00	2.00
Potash as sulfate (free from chloride),	5.00	5.00
Potash as muriate,	4.25	4.25

A comparison of the market costs of the different essential ingredients of plant food for 1904 with the previous year shows the following variation: nitrogen in the form of nitrates is a cent higher per pound; the higher grades of organic nitrogen, including nitrogen classed in high-grade mixed fertilizers, are half a cent higher in cost than for the year 1903; the cost of the different forms of phosphoric acid and potassium oxide remains the same as in the previous year.

As in the past, the above schedule of trade values was adopted by representatives of the Massachusetts, Connecticut, Rhode Island, Maine, Vermont and New Jersey experiment stations, at a conference held during the month of March, 1904, and is based upon the quotations in ton lots of the leading standard raw materials furnishing nitrogen, phosphoric acid and potash, and which go to make up the bulk of our commercial fertilizers. These quotations are taken from the fertilizer markets in centres of distribution in New England, New York and New Jersey during the six months preceding March, 1904.

Table A, on the following page, gives the average analysis of officially collected fertilizers for 1904; Table B gives a compilation of analyses, showing the maximum, minimum and average percentages of the different essential ingredients of plant food found in the special crop fertilizers, so called, put out by the different manufacturers during the season of 1904.

TABLE A. — *Average Analysis of Officially Collected Fertilizers for 1904 (Per Cent.).*

NATURE OF MATERIAL.	Moisture.	NITROGEN IN ONE HUNDRED POUNDS.		PHOSPHORIC ACID IN ONE HUNDRED POUNDS.							POTASSIUM OXIDE IN ONE HUNDRED POUNDS.	
							TOTAL.		AVAILABLE.			
		Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
Complete fertilizers, ...	10.67	2.96	2.73	4.30	3.66	2.87	10.60	9.11	7.89	7.55	5.47	5.22
Ground bones, ...	8.70	3.32	2.93	.42	7.37	16.12	23.91	22.24	7.80	8.39	-	-
Tankage, ...	10.39	7.02	5.49	-	5.11	5.10	10.21	15.20	5.26	-	-	-
Dry ground fish, ...	9.82	8.44	8.19	-	5.08	3.76	8.84	7.20	5.08	-	-	-
Dissolved bone-black, ...	10.92	-	-	12.81	3.00	1.70	17.51	15.50	15.81	15.00	-	-
Acid phosphate, ...	10.92	-	-	10.33	4.46	1.69	16.48	13.90	14.79	12.83	-	-
Wood ashes, ...	15.98	-	-	-	-	-	1.52	1.10	-	-	4.59	4.83
Cotton-seed meal, ...	7.44	6.79	7.00	-	-	-	-	-	-	-	-	-
Flax meal, ...	8.84	5.89	6.08	-	-	-	-	-	-	-	-	-
Nitrate of soda, ...	1.76	15.34	15.43	-	-	-	-	-	-	-	-	-
Sulfate of ammonia, ...	.13	20.20	19.00	-	-	-	-	-	-	-	-	-
High-grade sulfate of potash, . .	.49	-	-	-	-	-	-	-	-	-	49.65	48.00
Muriate of potash, ...	1.47	-	-	-	-	-	-	-	-	-	50.69	50.00
Dried blood, ...	15.13	10.80	6.78	-	-	-	-	-	-	-	-	-

TABLE B. — *Compilation of Analyses of Commercial Fertilizers for the Year 1904 (Per Cent.).*

NAME OF FERTILIZER.	Moisture.	NITROGEN IN ONE HUNDRED POUNDS.			TOTAL PHOSPHORIC ACID IN ONE HUNDRED POUNDS.			AVAILABLE PHOSPHORIC ACID IN ONE HUNDRED POUNDS.			POTASSIUM OXIDE IN ONE HUNDRED POUNDS.		
		Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.
Corn fertilizer,	11.83	5.38	1.12	2.34	14.82	8.72	11.08	10.76	5.86	8.44	8.96	1.54	3.58
Fruit and vine fertilizer,	11.29	3.86	2.46	3.02	13.02	7.82	9.58	9.26	7.08	7.23	11.08	5.62	8.42
Grain fertilizer,	9.67	7.81	.84	2.65	11.06	8.12	9.77	9.01	4.37	6.58	10.40	.88	3.82
Grass fertilizer,	7.83	5.31	2.49	4.08	14.71	5.06	9.14	13.08	2.68	6.81	11.94	2.20	5.33
Market-garden fertilizer,	11.53	4.09	1.73	2.87	11.54	8.65	10.56	9.09	6.91	8.18	10.00	2.08	6.18
Potato fertilizer,	11.38	4.68	1.71	2.63	14.44	6.98	10.27	12.58	4.12	8.08	10.08	2.58	5.64
Tobacco fertilizer,	10.14	5.97	.66	4.04	14.96	5.50	10.20	11.42	1.76	6.59	15.08	.72	8.18
Onion fertilizer,	10.95	3.42	1.61	3.02	12.18	8.24	9.88	8.93	6.84	7.97	10.48	6.78	7.78

A study of Table B teaches the same lessons as in the past. It is a much safer plan to study our fertilizer bulletins, when selecting a supply of commercial fertilizers, than to depend upon mere trade names. Oftentimes the fertilizer costing the most per ton is the cheapest and most economical fertilizer to use if applied to the soil intelligently. Every farmer should know the requirements of his soil, in order to judiciously select his supply of fertilizers. No iron-clad rule can be laid down for selecting fertilizers, as conditions vary so widely on different soils; it is safe to say, however, that for general use those fertilizers should be purchased which furnish the greatest amount of the three essential elements of plant food in a suitable and available form for the same money.

List of Manufacturers and Dealers who have secured Certificates for the Sale of Commercial Fertilizers in the State during the Past Year (May 1, 1904, to May 1, 1905), and the Brands licensed by Each.

The American Agricultural Chemical Co., Boston, Mass.: —
- Brightman's Fish and Potash.
- Double Manure Salt.
- Dissolved Bone-black.
- Dried Blood.
- Dry Ground Fish.
- Fine-ground Bone.
- Fine-ground Tankage.
- Grass and Lawn Top-dressing.
- Ground South Carolina Phosphate.
- High-grade Fertilizer with Ten Per Cent. Potash.
- High-grade Sulfate of Potash.
- Kainit.
- Muriate of Potash.
- Nitrate of Soda.
- Plain Superphosphate.
- Tobacco Starter and Grower.

The American Agricultural Chemical Co. (Bradley Fertilizer Co., branch), Boston, Mass.: —
- Abattoir Bone Dust.
- Bradley's Complete Manure for Corn and Grain.
- Bradley's Complete Manure for Onions.
- Bradley's Complete Manure for Potatoes and Vegetables.
- Bradley's Complete Manure for Top-dressing Grass and Grain.
- Bradley's Complete Manure with Ten Per Cent. Potash.
- Bradley's Corn Phosphate.
- Bradley's Eclipse Phosphate.

The American Agricultural Chemical Co. (Bradley Fertilizer Co., branch), Boston, Mass. — *Con.*
- Bradley's English Lawn Fertilizer.
- Bradley's Niagara Phosphate.
- Bradley's Potato Fertilizer.
- Bradley's Potato Manure.
- Bradley's Seeding-down Manure.
- Bradley's X L Superphosphate.
- Columbia Fish and Potash.
- Church's Fish and Potash.

The American Agricultural Chemical Co. (H. J. Baker & Bro., branch), New York, N. Y.: —
- Baker's A A Ammoniated Phosphate.
- Baker's Complete Potato Manure.

The American Agricultural Chemical Co. (Clark's Cove Fertilizer Co., branch), Boston, Mass.: —
- Clark's Cove Bay State Fertilizer.
- Clark's Cove Bay State Fertilizer, G G.
- Clark's Cove Great Planet Manure.
- Clark's Cove King Philip Guano.
- Clark's Cove Potato Fertilizer.
- Clark's Cove Potato Manure.

The American Agricultural Chemical Co. (Crocker Fertilizer and Chemical Co., branch), Buffalo, N. Y.: —
- Crocker's A A Complete Manure.
- Crocker's Corn Phosphate.
- Crocker's Potato, Hop and Tobacco Phosphate.

The American Agricultural Chemical Co. (Cumberland Bone Phosphate Co., branch), Boston, Mass.: —
Cumberland Potato Fertilizer.
Cumberland Superphosphate.

The American Agricultural Chemical Co. (L. B. Darling Fertilizer Co., branch), Pawtucket, R. I.: —
Darling's Blood, Bone and Potash.
Darling's Complete Ten Per Cent. Manure.
Darling's Farm Favorite.
Darling's General Fertilizer.
Darling's Potato and Root Crop Manure.
Darling's Potato Manure.
Darling's Tobacco Grower.

The American Agricultural Chemical Co. (Great Eastern Fertilizer Co., branch), Rutland, Vt.: —
Garden Special.
General Fertilizer.
Grass and Oats Fertilizer.
Northern Corn Special.
Vegetable, Vine and Tobacco.

The American Agricultural Chemical Co. (Pacific Guano Co., branch), Boston, Mass.: —
Pacific High-grade General.
Pacific Nobsque Guano.
Pacific Potato Special.
Soluble Pacific Guano.

The American Agricultural Chemical Co. (Packers' Union Fertilizer Co., branch), Rutland, Vt.: —
Animal Corn Fertilizer.
Gardener's Complete Manure.
Potato Manure.
Universal Fertilizer.
Wheat, Oats and Clover Fertilizer.

The American Agricultural Chemical Co. (Quinnipiac Co., branch), Boston, Mass.: —
Quinnipiac Climax Phosphate.
Quinnipiac Corn Manure.
Quinnipiac Havana Tobacco Fertilizer.
Quinnipiac Market-garden Manure.
Quinnipiac Onion Manure.
Quinnipiac Phosphate.
Quinnipiac Potato Manure.
Quinnipiac Potato Phosphate.

The American Agricultural Chemical Co. (Read Fertilizer Co., branch), New York, N. Y.: —
Read's Farmers' Friend.
Read's High-grade Farmers' Friend.
Read's Practical Potato Special.
Read's Standard.
Read's Vegetable and Vine.

The American Agricultural Chemical Co. (Standard Fertilizer Co., branch), Boston, Mass.: —
Standard Complete Manure.
Standard Fertilizer.
Standard Guano.
Standard Special for Potatoes.

The American Agricultural Chemical Co. (Henry F. Tucker Co., branch), Boston, Mass.: —
Tucker's Original Bay State Bone Superphosphate.
Tucker's Special Potato Fertilizer.

The American Agricultural Chemical Co. (Williams & Clark Fertilizer Co., branch), Boston, Mass: —
Williams & Clark's Americus Phosphate.
Williams & Clark's Corn Phosphate.
Williams & Clark's High-grade Special.
Williams & Clark's Potato Manure.
Williams & Clark's Potato Phosphate.
Williams & Clark's Prolific Crop Producer.
Williams & Clark's Royal Bone Phosphate.

The American Agricultural Chemical Co. (M. E. Wheeler & Co., branch), Rutland, Vt.: —
Corn Fertilizer.
Bermuda Onion Grower.
Grass and Oats Fertilizer.
Havana Tobacco Fertilizer.
Potato Manure.

W. H. Abbott, Holyoke, Mass.: —
Animal Fertilizer.
Eagle Brand.
Tobacco Fertilizer.

The Abbott & Martin Rendering Co., Columbus, O.: —
Abbott's Tobacco and Potato Special.
Harvest King.
Ideal Grain Grower.

The American Cotton Oil Co., New York, N. Y.: —
Cotton-seed Meal.
Cotton-seed Hull Ashes.

American Linseed Co., New York, N. Y.: —
Cleveland Flax Meal.

Armour Fertilizer Works, Baltimore, Md.: —
All Soluble.
Ammoniated Bone with Potash.
Bone Meal.
Blood, Bone and Potash.
Grain Grower.
High-grade Potato.

H. J. Baker and Bro., New York, N Y.: —
Castor Pumace.

Beach Soap Co., Lawrence, Mass.: —
Beach's Advance Brand.
Beach's Fertilizer Bone.
Beach's Reliance.
Beach's Universal.

Berkshire Fertilizer Co., Bridgeport, Conn.: —
Berkshire Complete Fertilizer.
Berkshire Ammoniated Bone Phosphate.
Berkshire Potato and Vegetable Phosphate.

Joseph Breck & Sons, Boston, Mass.: —
Breck's Lawn and Garden Dressing.
Breck's Market-garden Manure.

Bowker Fertilizer Co., Boston, Mass.: —
Bone, Blood and Potash.
Bowker's Ammoniated Food for Flowers.
Bowker's Bone and Wood Ash Fertilizer.
Bowker's Complete Mixture.
Bowker's Double Manure Salts.
Bowker's Farm and Garden Phosphate.
Bowker's Fish and Potash (Square Brand).
Bowker's Ground Bone.
Bowker's High-grade Fertilizer.
Bowker's Hill and Drill Phosphate.
Bowker's Kainit.
Bowker's Lawn and Garden Dressing.
Bowker's Potato and Vegetable Fertilizer.
Bowker's Potash Bone.
Bowker's Market-garden Fertilizer.
Bowker's Potato and Vegetable Phosphate.
Bowker's Soluble Animal Fertilizer.
Bowker's Special Onion Manure.
Bowker's Superphosphate.
Bowker's Sure Crop Phosphate.
Bowker's Tankage.
Bowker's Ten Per Cent. Manure.
Bowker's Tobacco Ash Fertilizer.
Bowker's Tobacco Starter.
Bristol Fish and Potash.
Corn Phosphate.
Dissolved Bone-black.
Dried Blood.
Early Potato Manure.
Fine Dry Ground Fish.
Fish and Potash (D Brand).
Gloucester Fish and Potash.
Muriate of Potash.
Nitrate of Soda.
Stockbridge Special Manures.
Sulfate of Ammonia.

Bowker Fertilizer Co., Boston, Mass. — *Con.*
Sulfate of Potash.
Tobacco Ash Elements.
Wood Ashes.

T. H. Bunch, Little Rock, Ark.: —
Cotton-seed Meal.

Charles M. Cox & Co., Boston, Mass.: —
Cotton-seed Meal.

Chicopee Rendering Co., Springfield, Mass.: —
Pure Ground Bone.
Complete Animal Fertilizer.
Lawn and Garden Dressing.
Tankage.

E. Frank Coe Co., New York, N. Y.: —
American Farmers' Ammoniated Bone.
American Farmers' Complete Manure.
American Farmers' Corn King.
American Farmers' Grass and Grain.
American Farmers' Market-garden Special.
Columbian Corn Fertilizer.
Columbian Potato Fertilizer.
E. Frank Coe's F P Fish and Potash.
E. Frank Coe's Gold Brand Excelsior Guano.
E. Frank Coe's High-grade Ammoniated Bone Superphosphate.
E. Frank Coe's Nitrate of Soda.
E. Frank Coe's Tobacco and Onion Fertilizer.
Celebrated Special Potato.
Excelsior Potato Fertilizer.
New Englander Corn Fertilizer.
New Englander Potato Fertilizer.
Red Brand Excelsior Guano.
X X X Ground Bone.

John C. Dow & Co., Boston, Mass.: —
Dow's Pure Ground Bone.

Eastern Chemical Co., Boston, Mass.: —
Imperial Grass Fertilizer.
Imperial Plant Food.

William E. Fyfe & Co., Clinton, Mass.: —
Canada Unleached Hard-wood Ashes.

R. & J. Farquhar & Co., Boston, Mass.: —
Clay's London Fertilizer.
Thompson's Improved Vine, Plant and Vegetable Manure.

Hargraves Soap Co., Fall River, Mass.: —
Ground Bone Fertilizer.

The Hardy Packing Co., Columbus, O.: —
Hardy's Complete Manure.
Hardy's Tankage, Bone and Potash.
Hardy's Tobacco and Potato Special.

C. W. Hastings, Cambridgeport, Mass.:—
  Ferti Flora.

Thomas Hersom & Co., New Bedford, Mass.:—
  Bone Meal.
  Meat and Bone.

John Joynt, Lucknow, Can.:—
  Pure Canada Unleached Hard-wood Ashes.

Lister's Agricultural Chemical Works, Newark, N. J.:—
  Lister's Animal Bone and Potash.
  Lister's High-grade Special.
  Lister's Oneida Special.
  Lister's Potato Manure.
  Lister's Special Corn.
  Lister's Special Potato.
  Lister's Success Fertilizer.

Lowell Fertilizer Co., Boston, Mass.:—
  Acid Phosphate.
  Muriate of Potash.
  Nitrate of Soda.
  Swift's Lowell Animal Brand.
  Swift's Lowell Bone Fertilizer.
  Swift's Lowell Dissolved Bone and Potash.
  Swift's Lowell Dissolved Bone-black.
  Swift's Lowell Empress Brand.
  Swift's Lowell Ground Bone.
  Swift's Lowell Lawn Dressing.
  Swift's Lowell Market Garden.
  Swift's Lowell Potato Manure.
  Swift's Lowell Potato Phosphate.
  Swift's Lowell Tankage.

George E. Marsh & Co., Lynn, Mass.:—
  Pure Bone Meal.

Mapes Formula and Peruvian Guano Co., New York, N. Y.:—
  Average Soil Complete Manure.
  Cauliflower and Cabbage Manure.
  Complete Manure (A Brand).
  Complete Manure for General Use.
  Complete Manure Ten Per Cent. Potash.
  Corn Manure.
  Economical Potato Manure.
  Fruit and Vine Manure.
  Grass and Grain Spring Top-dressing.
  Lawn Top-dressing.
  Potato Manure.
  Tobacco Ash Constituents.
  Tobacco Manure Wrapper Brand.
  Tobacco Starter Improved.
  Top-dressing Improved, One-half Strength.
  Vegetable Manure or Complete Manure for Light Soils.

D. M. Moulton, Monson, Mass.:—
  Ground Bone.

National Fertilizer Co., Bridgeport, Conn.:—
  Chittenden's Ammoniated Bone.
  Chittenden's Complete Fertilizer.
  Chittenden's Fish and Potash.
  Chittenden's High-grade Special.
  Chittenden's Market Garden.
  Chittenden's Potato Phosphate.
  Chittenden's Tobacco Manure.

New England Fertilizer Co., Boston, Mass.:—
  Corn Phosphate.
  Potato Fertilizer.
  Superphosphate.

Olds & Whipple, Hartford, Conn.:—
  Complete Tobacco Fertilizer.
  Vegetable Potash.

R. T. Prentiss, Holyoke, Mass.:—
  Complete Fertilizer.

Parmenter & Polsey Fertilizer Co., Peabody, Mass.:—
  A A Brand.
  Acid Phosphate.
  Lawn Dressing.
  Grain Grower.
  Muriate of Potash.
  Nitrate of Soda.
  P. & P. Potato.
  Plymouth Rock Brand.
  Special Fertilizer for Strawberries.
  Special Potato.
  Sulfate of Potash.

Jacob Reese, Darby, Penn.:—
  Odorless Slag Phosphate.

Rogers & Hubbard Co., Middletown, Conn.:—
  Hubbard's All Soils and All Crops Fertilizer.
  Hubbard's Corn Phosphate.
  Hubbard's Grass and Grain Fertilizer.
  Hubbard's Oats and Top-dressing.
  Hubbard's Potato Phosphate.
  Hubbard's Pure Raw Knuckle Bone Flour.
  Hubbard's Soluble Corn.
  Hubbard's Soluble Potato Manure.
  Hubbard's Soluble Tobacco Manure.
  Hubbard's Strictly Pure Fine Bone.

Rogers Manufacturing Co., Rockfall, Conn.:—
  All Round Fertilizer.
  Complete Corn and Onion.
  Complete Fish and Potash.

Rogers Manufacturing Co., Rockfall, Conn. — *Con.*
- Complete Potato and Vegetable.
- High-grade Grass and Grain.
- High-grade Oats and Top-dressing.
- High-grade Tobacco and Potato.
- High-grade Soluble Tobacco.
- Nitrate of Soda.
- Pure Fine-ground Bone.

Ross Bros., Worcester, Mass.: —
- Ross Brother's Lawn Dressing.

N. Roy & Son, South Attleborough, Mass.: —
- Complete Animal Fertilizer.

Russia Cement Co., Gloucester, Mass.: —
- Essex Complete Manure for Corn, Grain and Grass.
- Essex Complete Manure for Potatoes, Roots and Vegetables.
- Essex Corn Fertilizer.
- Essex Dry Ground Fish.
- Essex A I Superphosphate.
- Essex Market Garden and Potato Manure.
- Essex Odorless Lawn Dressing.
- Essex Rhode Island Special for Potatoes and Roots.
- Essex Special Tobacco Manure.
- Essex Tobacco Starter.
- Essex X X X Fish and Potash.
- Muriate of Potash.
- Nitrate of Soda.

Salisbury Cutlery Handle Co., Salisbury, Conn.: —
- Fine Bone.

M. L. Shoemaker & Co., Limited, Philadelphia, Penn.: —
- Swift Sure Superphosphate for General Use.
- Swift Sure Bone Meal.

Sanderson's Fertilizer and Chemical Co., New Haven, Conn.: —
- Sanderson's Corn Superphosphate.
- Sanderson's Fine-ground Fish.
- Sanderson's Formula A.
- Sanderson's Formula B.
- Sanderson's Sulfate of Potash.
- Sanderson's Potato Manure.
- Sanderson's Special with Ten Per Cent. Potash.
- Sanderson's Top-dressing for Grass and Grain.

Thomas L. Stetson, Randolph, Mass.: —
- Bone Meal.

J. Stroup, Son & Co., Boston, Mass.: —
- Canada Hard-wood Unleached Ashes.

A. L. Warren, Northborough, Mass.: —
- Warren's Ground Bone.

The Whitman & Pratt Rendering Co., Lowell, Mass.: —
- Whitman & Pratt's All Crops.
- Whitman & Pratt's Corn Success.
- Whitman & Pratt's Potato Plowman.
- Whitman & Pratt's Pure Ground Bone.

Wilcox Fertilizer Works, Mystic, Conn.: —
- Complete Bone Superphosphate.
- Dry Ground Fish.
- Fish and Potash.
- High-grade Tobacco Special.
- Potato Fertilizer.
- Potato, Onion and Vegetable.

Sanford Winter, Brockton, Mass.: —
- Pure Fine-ground Bone.

J. M. Woodard & Bro., Greenfield, Mass.: —
- Tankage.

A. H. Wood & Co., Framingham, Mass.: —
- A A Brand.
- B B Brand.
- C C Brand.

PART II. — REPORT ON GENERAL WORK IN THE CHEMICAL LABORATORY.

C. A. GOESSMANN.

1. Analyses of materials forwarded for examination.
2. Notes on wood ashes and lime ashes.
3. Notes on phosphatic slag and experiments with native phosphates.

1. ANALYSES OF MATERIALS FORWARDED FOR EXAMINATION.

This department of our work has been of the same general character as in past years. We have received during the season 283 samples of miscellaneous substances from farmers within our State for analysis; this is 48 more than was received during the season of 1903.

As far as time and facilities permit, we have devoted our attention to the examination of this class of materials, the substances being taken up for analysis in the order of their arrival at this office. During the season of the official inspection of commercial fertilizers, April 1 to November, our time is so completely occupied that work in this class of general materials, for the benefit of individual farmers, has to give place, in a measure, to the control work of inspection. For this reason we would urge those sending samples for free analysis to forward them, so far as possible, between November 1 and April 1, thus insuring more prompt reports in results of analysis.

As in the past, we have taken an active part in the technical work of the Association of Official Agricultural Chemists for the establishment of new methods of analysis. Many determinations were made on samples forwarded by the association to test the efficacy of several new methods of determining potash and the various forms of phosphoric acid.

Following is a list of materials forwarded by farmers and agricultural organizations during the season of 1904: —

Wood ashes, . . .	50
Soils, ...	47
Complete fertilizers, . .	32
Lime ashes, ...	14
Tankage, ...	10
Ground bone, . . .	9
Nitrate of soda, . . .	8
Miscellaneous substances, .	9
Low-grade sulfate of potash,	7
Muck, ...	7
Meadow mud, . . .	7
Cotton-seed meal, . .	6
Dry ground fish, . . .	5
Mill refuse, ...	5
Manure, ...	5
Acid phosphate, . . .	4
Peat, ...	4
Cotton-hull ashes, . .	3
Muriate of potash, . .	3
Lime, ...	3
Dissolved bone-black, . .	3
Cotton-seed droppings, .	2
Cotton-seed dust, . . .	2
Sulfate of ammonia, . .	2
Carbonate of potash, . .	2
Phosphatic slag, . . .	2
Steamed bone, ...	2
Wool dust, ...	2
Wool waste, ...	2
Dried blood, ...	2
Sewage, ...	2
Pulp ashes, ...	1
Cotton compost, ...	1
Carbonate of potash-magnesia,	1
Silicate of potash, . .	1
High-grade sulfate of potash,	1
Nitrate of potash, ...	1
Belgian phosphate, . .	1
Raw bone, ...	1
Dissolved bone, . . .	1
Lime and nitrate of soda, .	1
Guinea pig manure, . .	1
Liquid manure, . . .	1
Sheep manure, ...	1
Lime refuse from tannery, .	1
Waste lime, ...	1
Granulated lime, ...	1
Plaster, ...	1
Raw hide dust, . . .	1
Cocoa shells, ...	1
Dandelion roots, ...	1
Clover roots, ...	1

2. NOTES ON WOOD ASHES AND LIME ASHES.

(*a*) *Wood Ashes.* — Seventeen and one-half per cent. of the materials forwarded for analysis during the season have been wood ashes, being about the same proportion as that for the year 1903. The following abstract of results of analysis shows their general chemical character, also a comparison in results of analysis with the previous year 1903: —

Analysis of Wood Ashes.

	Number of Samples.	
	1903.	**1904.**
Moisture from 1 to 10 per cent.,	11	18
Moisture from 10 to 20 per cent.,	14	16
Moisture from 20 to 30 per cent.,	9	8
Moisture above 30 per cent.,	3	3
Potassium oxide above 8 per cent.,	2	2
Potassium oxide from 6 to 7 per cent.,	4	8
Potassium oxide from 5 to 6 per cent.,	8	6
Potassium oxide from 4 to 5 per cent.,	12	12
Potassium oxide from 3 to 4 per cent.,	8	10
Potassium oxide below 3 per cent.,	3	7
Phosphoric acid from 1 to 2 per cent.,	34	30
Phosphoric acid above 2 per cent.,	none	3
Phosphoric acid below 1 per cent.,	3	12
Average per cent. of calcium oxide (lime),	29.39	30.16
Insoluble matter below 10 per cent.,	7	6
Insoluble matter from 10 to 15 per cent.,	12	18
Insoluble matter above 15 per cent.,	17	20

Table showing the Maximum, Minimum and Average Per Cents. of the Different Ingredients found in Wood Ashes for the Seasons of 1903 and 1904.

	Maximum.		Minimum.		Average.	
	1903.	**1904.**	**1903.**	**1904.**	**1903.**	**1904.**
Moisture,	37.34	37.85	2.27	none	15.23	14.42
Potassium oxide,	8.15	11.04	1.68	.80	4.76	4.51
Phosphoric acid,	1.80	6.07	.46	.28	1.37	1.37
Calcium oxide,	35.75	42.86	22.33	19.73	29.39	30.16
Insoluble matter,	28.85	47.21	1.40	4.56	15.07	18.35

From the above tables it will be seen that the percentage of potassium oxide in the wood ashes received during the season is, on the average, somewhat less than for the previous season. The average of phosphoric acid is the same; while the average percentage of lime is somewhat higher than for 1903.

A study of these tables will emphasize the importance of buying this class of material on a statement of a guaranteed composition. We would urge all parties to ask for a positive guarantee of the amount of potassium oxide, phosphoric acid and calcium oxide (although our State law does not oblige the manufacturer to guarantee the latter element, it should be required when buying this class of fertilizers) said to be contained in this or similar classes of fertilizers. We would also advise all parties to patronize those dealers and importers who have complied with our State laws by securing a license for the sale of their article in Massachusetts. It is only in this way that protection by our State laws can be secured.

(*b*) *Lime Ashes.* — What has been said regarding wood ashes applies with equal force to lime ashes. They should always be bought on a statement of the guarantee of lime, potash and phosphoric acid which they contain, as they are more apt to vary widely in chemical composition than even wood ashes.

Table showing the Maximum, Minimum and Average Per Cents. of the Different Ingredients found in Lime Ashes for the Seasons of 1903 and 1904.

	MAXIMUM.		MINIMUM.		AVERAGE.	
	1903.	**1904.**	**1903.**	**1904.**	**1903.**	**1904.**
Moisture,	23.16	36.62	10.47	none	15.66	10.88
Potassium oxide,	3.32	2.46	.76	.06	1.86	1.54
Phosphoric acid,	1.66	1.48	.03	trace	.63	.74
Calcium oxide,	55.44	55.24	32.42	21.92	41.15	42.93
Insoluble matter,	26.50	25.47	1.10	2.76	6.46	8.11

From the above comparison it will be seen that the lime ashes during the present season analyzed a little higher in lime and a little lower in potash than in 1903.

3. NOTES ON PHOSPHATIC SLAG AND EXPERIMENTS WITH NATIVE PHOSPHATES.

In one of our previous annual reports (thirteenth annual report, 1901, of Hatch Experiment Station of Massachusetts Agricultural College, pp. 68–70) we have discussed in detail the history and timely appearance of the basic slag phosphate in our general markets. In this article we pointed out the special modes of analysis that were in use in testing this material, also certain changes that have taken place in many localities in preparing the phosphatic slag by the addition of silica in a fusing process to change the free lime which is present in the slag to a silicate of lime, thus showing, it is claimed, a larger percentage of available phosphoric acid.

Samples of phosphatic slag have been collected in our general markets during the past year. This would indicate that this class of material was claiming the attention of agriculturists more than in the past. The extensive introduction of new methods of iron manufacture has largely increased the supply of phosphatic slag. Results of field experiments have shown the superior value of this material and demonstrated its fitness as a manurial matter. In view of the above facts, we have again taken this subject up for discussion.

The following table gives the results of analysis of samples of phosphatic slag made at the laboratory during 1904, in comparison with the average of analyses of slags made at the station in years past. Sample I. was imported from England in 1904; Sample II. was collected in our general markets during the spring of 1904; Sample III. was the average of all previous analyses made at the station.

Analysis of Samples (Per Cent.).

	Sample I.	Sample II.	Sample III.
Moisture,	.15	none	.99
Total phosphoric acid,	18.61	20.52	20.61
Available phosphoric acid,	–	4.96	4.05
Insoluble phosphoric acid,	–	15.56	19.03
Calcium oxide,	50.58	46.78	50.32
Insoluble matter,	–	18.78	6.59

From the results of the above compilation of analyses it will be seen that the present phosphatic slag does not differ materially from that of the past. The two samples analyzed during the year showed the presence of free lime, which fact was recognized and the mode of analysis was so modified as to counteract the action of the free lime before subjecting the samples to the usual treatment with neutral citrate of ammonia for the dermination of the available phosphoric acid.

The attempt to imitate the phosphatic slag, by fusing apatite with soda ash at 600° to 800° C., was mentioned in our previous annual report. Observations have been extended along this line during recent years by fusing natural phosphates with carnallite and kieserite for ten to fifteen minutes, at a temperature of 650° to 800° C. This treatment gave a compound analyzing: —

	Per Cent.
Total phosphoric acid, ...	20.71
Phosphoric acid soluble in 2 per cent. citric acid solution, ...	15.23
Calcium oxide, ...	9.92
Magnesium oxide, ...	10.20
Potassium oxide, ...	6.85
Chlorine, ...	16.47

It was reported that the effect of this fertilizer on oats and peas was somewhat superior to phosphatic slag, as regards the yield of grain.

Another substitute for slag phosphate is described by Prof. P. Wagner: 100 parts of coarsely crushed phosphorite is fused with 70 parts of acid sodium sulfate; 20 parts of calcium carbonate, 22 parts of sand and 6 to 7 parts of coal; this gave a product testing 15.7 per cent. phosphoric acid, practically all of which was soluble in citric acid solution. Pot experiments were conducted on oats, grown on loam soil, by the aid of this mixture, alongside of similar experiments conducted with a superphosphate testing 17.7 per cent. water-soluble phosphoric acid and 18.9 per cent. total phosphoric acid and phosphatic slag, testing 18 per cent. citric acid soluble phosphoric and 19.9 per cent. total phosphoric acid. The fused mixture gave as quick-acting and effective results as the superphosphate, and also gave results superior to the basic slag phosphate.

During the winter of 1902 Mr. H. D. Haskins of this department made some interesting experiments in fusing Canadian apatite with a mixture of sodium and potassium carbonates. The apatite was a high-grade material, testing

31.22 per cent. phosphoric acid and 51.74 per cent. calcium oxide. His experiments were conducted as follows: 1 part of the apatite was fused with 4 parts of a mixture composed of 23 parts of sodium carbonate and 39 parts of potassium carbonate. The resulting mass was extracted with water, and showed a test of 3.68 per cent. water-soluble phosphoric acid. The residue, upon treatment with neutral citrate of ammonia, showed a test of 26.78 per cent. of reverted phosphoric acid, leaving only .76 per cent. of phosphoric acid in an insoluble form. In another experiment 1 part of the apatite was fused with 1.15 parts of the same fusing mixture, this amount of sodium and potassium carbonate being theoretically necessary to convert all of the phosphoric acid into phosphates of soda and potash. The resulting mass showed 2.56 per cent. of water-soluble phosphoric acid, 15.96 per cent. of reverted phosphoric acid and 12.70 per cent. of insoluble phosphoric acid. Mr. Haskins also made experiments to ascertain to what extent the phosphoric acid in apatite would become available if boiled with a solution of sodium and potassium carbonate. Several strengths of solution were used, but only traces of phosphoric acid were dissolved, the residue in no case showing over 1.98 per cent. available phosphoric acid. From the above observations it will appear that great fields are opened for a more extensive use of our natural phosphates when introduced in a suitable form by some fusing process.

In conclusion, we must say that the consumption of commercial fertilizers is ever on the increase, and it is a great satisfaction to feel that apparently the increased consumption of fertilizers is more than off-set by the prospective increase in natural supplies. The increased production of sulfate of ammonia from improved methods in the manufacture of coke from bituminous coal, the recent discoveries of new potash deposits in Saxony, Ger., as well as the recent reported discovery of nitrate of soda beds along the Pacific coast in the United States, all furnish pleasant reflections for the future of American agriculture.

REPORT OF THE ENTOMOLOGISTS.

C. H. FERNALD, H. T. FERNALD.

A number of different lines of investigation have been begun or continued during the year 1904, in addition to what may be termed the routine work of the division.

Experiments to determine the best treatment for the San José scale, begun at this station in 1902, have been concluded, at least for the present, as they have resulted in so thoroughly freeing the college orchard from this pest as to leave no material for further experiment. It is true that the scale is not exterminated, but it is present in such small numbers that several years must elapse before the orchard will become so reinfested as to be of any value for experimental purposes. On the other hand, it is impossible under present conditions to attempt experimental work elsewhere, and therefore this line of research is at least temporarily suspended.

A number of private preparations claiming to be useful as insecticides have been tested during the year, with varying results; but none have thus far been found which appear to be of great value. Whether it is worth while to take the large amount of time necessary for these tests, when the results, if they should ever by any chance prove valuable, would practically only produce free advertising to those manufacturing them, is certainly questionable, particularly as scarcely any of these substances are made by residents of this State.

The codling moth is now treated by spraying during the egg-laying period of this insect. In the west there are several broods of this pest each year, but in Massachusetts there seems to be much uncertainty on this point. For two years observations have been conducted to determine the number of broods of this insect, and the proper times at which to spray the trees in order to obtain the best results. The difference in seasons is of course a factor in the determination of these points, and renders it necessary that the work be continued for a term of years before final results can be obtained.

The oyster-shell scale can easily be controlled by mild sprays if these are applied at the right times, but two years ago no one in Massachusetts seemed to know just that time. In States but a short distance south this pest has two broods, and it has been doubtful whether there were not two here also. In order to determine these questions, careful observations have been made during the last two years, and must be continued for several more in order to obtain reliable results.

For nearly three months of the year all the spare time of the entomologists was devoted to the preparation of an exhibit for the Louisiana Purchase Exposition, taking time which could otherwise have been devoted to experimental work. The nature and scope of this exhibit has been presented elsewhere, and need not be given here.

During the colder months of the year experimental work is practically impossible, and this time is made use of in putting together the results of previous investigations, and drawing conclusions from them; in classifying and arranging the materials gathered and received during the summer; in solving the more complex problems connected with cases of injury difficult to reach and control by ordinary means; and in original investigations of various kinds.

The correspondence with residents of the State requires a large amount of time. In 1903 this was less than usual, the reasons for it being considered in the last report. This year it has resumed its normal quantity, about 1,500 inquiries having been received and answered by letter, or by sending printed information on the topics concerned.

Particular effort has been made to obtain samples of the injuries caused by insects, these being often markedly characteristic, and therefore of the greatest utility in a collection so constantly referred to.

The card catalogue has now been installed in a new case, capable of holding 90,000 cards, and is in constant use; in fact, it is probably the most useful single piece of apparatus in the possession of the division. Additional cards are constantly being added as new literature is published.

INSECTS OF THE YEAR.

The unusually cold weather during the winter of 1903–04, together with a few sudden and marked fluctuations of the temperature, was not without its effect upon insect life, as was shown last summer, though perhaps less than might have been expected.

The San José scale was destroyed in large numbers by the winter-killing of trees, and to some extent on those which survived the winter. This demonstrates that this insect is not entirely hardy during severe winters in this latitude. Unfortunately, enough succeeded in living to produce many young during the summer, so that this insect is now somewhat more abundant than it was a year ago. It is generally distributed over the State east of the western slopes of the Connecticut valley, but seems not to have penetrated the Berkshire hills to any great extent. Spraying with the lime-sulphur mixture for this pest has been made use of by many fruit growers and others, and has proved to be an excellent method for its control.

Plant lice and root maggots have been fairly abundant this year, due perhaps to their great increase during 1903 enabling them to have so many descendants that a larger number than usual succeeded in passing the winter.

The white fly (*Aleyrodes*) in greenhouses has apparently spread in all directions, complaints of the destruction it has caused having been received from all parts of the State.

The red spider (*Tetranychus*, spp.) has also been very abundant, both in greenhouses and outside, where a characteristic brownish tinge on the leaves of affected plants has often been very noticeable.

The usual amount of correspondence about the treatment for ants in houses and on lawns, about cut-worms, wire worms, the oyster-shell and scurfy scales and the various soft scales, indicates that these pests have been as abundant as ever, and that many people are still entirely ignorant of the appearance of their commonest insect foes.

The brown-tail moth has continued to spread over the State, and has been found in Lunenburg, Clinton and Whitman, by the State nursery inspectors. This indicates that the insect is spreading westward rapidly, and that it will be present in all parts of Massachusetts within a very few years. During the middle of July, while the moths were flying, it was noticeable that they were attracted to light, many being destroyed by flying into open arc lights on the streets, in some cases falling to the ground below the lights in such numbers as to form heaps of noticeable size.

It has usually been believed that the amount of feeding done by these insects in the fall was so slight that it could be ignored. This year, however, the caterpillars, after hatching and even after forming their tents, fed so much that where they were abundant all the foliage was skeletonized and turned brown. This was very noticeable in parts of Belmont, Arlington, Winchester and elsewhere. After the pear and apple, oaks seemed to be a favorite food for this insect, and the browning of the foliage in places was so great that newspapers called attention to "an extra brood" of this pest, and in some cases discovered that it was "a new and hitherto unknown insect" which was causing the injury.

The gypsy moth is now generally distributed over its original territory, and in one or two places has spread beyond it. In the districts where it is most abundant, the destruction it formerly caused when unchecked is again seen, and the result if no means of repression or control are taken can easily be imagined by any one who has visited these places. Local organizations in the infested districts are taking action to destroy this and the brown-tail moth, and are doing splendid work; but this should be supplemented by work on broader lines and with more power than local organizations possess, if lasting results are to be hoped for.

REPORT OF THE AGRICULTURISTS.

WM. P. BROOKS; ASSISTANTS, F. R. CHURCH, S. B. HASKELL.

The work of the agricultural department of the experiment station during the past year has in the main followed the general lines of investigation which have recently engaged attention. These for the most part are connected with questions affecting the selection and use of manures and fertilizers. To give results of value, such experiments require numerous repetitions, because of variation in product due to seasons and to conditions which we cannot fully control. In the averages of a series of years the influence of such variations is in a measure eliminated, and deductions based upon such averages will serve as a basis in farm practice.

The work of the past season has involved the care of over 220 plots in the open field, 150 closed plots and 278 pots in vegetation experiments.

Our grass garden, which includes 48 species and 7 varieties, most of them occupying 1 square rod of land, has been cared for as usual. One-half of the area in each species has been kept constantly lawn-mown, with a view to studying the probable effects of grazing; and a considerable number of species which had become mixed have been renewed, after paring and burning the old turf for the destruction of seeds and roots of weeds and other grasses.

Numerous experiments with alfalfa, both on our own grounds and on the grounds of selected farmers, are in progress. The results of this work are to be given in a bulletin. It suffices for the present to say that we have nowhere attained results so satisfactory that the extensive sowing of this crop can be advised; it must still be regarded as in the experimental stage.

A few cultures of nitrogen-assimilating bacteria, sent out by the Department of Agriculture for use with legumes, have been tried, and, so far as can be judged, with disappointing results. A bulletin descriptive of this work and the results obtained will be prepared in due time.

We have increased the scope of our work with the new and promising varieties of timothy received from Prof. A. D. Hopkins of the West Virginia Experiment Station, five years ago. Several of these are distinct improvements upon the ordinary commercial timothy, and these are being increased as rapidly as possible, for the production of seed which will later be furnished to selected farmers for trial.

Variety work with wheat, oats and barley has engaged considerable attention. Seeds of 31 varieties which for a series of years had given remarkable crops in the Dominion of Canada were kindly donated for the purpose by Dr. William Saunders, director, Experimental Farms of Canada. It was hoped that these northern-grown grains might prove valuable, but the results were disappointing. Practically all varieties were affected by rust, and the yields of most were small. The range of variation in the crops obtained was as follows: for wheat, at the rate of from 6 to 15 bushels per acre; for barley, at the rate of from 6 to 26 bushels per acre; for oats, at the rate of from 40 to 55 bushels per acre. Among the varieties of oats, the Improved Ligowa, Bavarian, Thousand $ and Wide Awake gave the best yields, — all in excess of 50 bushels. These varieties would seem to be worthy of further attention.

The work with poultry has been along the same lines as last year, the relations of food combinations to egg production being the subject under investigation.

The statement of results obtained, presented in detail in this report, does not cover all the experiments in progress.

The principal subjects of inquiry discussed, and the more important results, are as follows: —

I. — To determine the relative value of barnyard manure, nitrate of soda, sulfate of ammonia and dried blood as sources of nitrogen. The crop of this year was potatoes, and, on the basis of yield, the rank of the nitrogen-furnishing materials is as follows: barnyard manure, nitrate of soda, dried blood, sulfate of ammonia. The nitrate ranks relatively lower this year than in any previous year of the experiment except last. On the basis of increases in all the crops grown since the experiment began, as compared with the no-nitrogen plots, the materials rank as follows: nitrate of soda, 100; barnyard manure, 83.6; dried blood, 66.9; sulfate of ammonia, 56.9. In this experiment we are also testing the stubble value to succeeding crops of legumes on the no-nitrogen plots. The results of this year indicate the soy bean crop stubble to have been of little value.

II. — To determine the relative value of muriate, as compared with high-grade sulfate of potash, for field crops. The results of this year indicate the sulfate to be considerably superior to the muriate both for rhubarb and for cabbages.

III. — To determine the relative value of different potash salts for field crops. The salts under comparison are high-grade sulfate, low-grade sulfate, kainit, muriate, nitrate, carbonate and silicate. The crops of this year were cabbages, field corn and ensilage corn. The most striking results of the comparison are the relatively very low yield of the silicate of potash and the relatively high yields obtained on the nitrate and the carbonate.

IV. — To determine the relative value of phosphates used in quantities furnishing equal phosphoric acid to each plot. The crop of this year was corn. The most striking result was the very inferior yield produced on the plot where Florida soft phosphate is used. This result, in exact agreement with results with different crops in earlier years, indicates a very low degree of availability for this phosphate.

V. — *A*. Soil test with corn. The crop of this year, the sixteenth during which the experiment has continued, was excellent on all plots to which potash has been annually applied. Where muriate of potash alone has been continuously used, the yield was at the rate of about 47 bushels per acre. Where muriate of potash and dissolved boneblack have been continuously used, the yield was at the rate of 53 bushels per acre, which is the best crop produced on any combination of fertilizers, and actually exceeds the yield on the plot where manure has been annually applied at the rate of 5 cords per acre. The experiment strikingly shows the great importance of the liberal supply of potash in fertilizers for the corn crop. *B.* Soil test with grass and clover. The nitrate of soda, whether used alone or in combination, caused a large increase in the first crop. The use of potash without lime had little effect upon the crop. Where potash has been used continuously for fifteen years, with two heavy applications of lime (in 1899 and 1904), the effect on the proportion of clover and on total yield was very marked. The most profitable crop produced by any fertilizer combination was obtained upon the plot to which dissolved bone-black and muriate of potash have been continuously applied. On the limed portion of this plot the yield is at the rate of 6,100 pounds of hay. The annual cost of the fertilizers applied to this plot has been $7.50.

VI. — To determine the relative value in crop production of a fertilizer mixture rich in potash, as compared with one representing the average of the special corn fertilizers purchasable in our markets. The result of this year is substantially equal crops under the two systems of manuring, at a cost of rather over $5 per acre less for the combination of fertilizers richer in potash.

VII. — To determine the relative value in corn production of a moderate application of manure alone, as compared with a smaller application of manure used in combination with 160 pounds of high-grade sulfate of potash per acre. The result of this year was crops under the two systems equal in amount of stover, but an average at the rate of 5 bushels of grain per acre less on the combination of manure and potash than on the manure alone. The difference in crop is not sufficient to cover the excess in cost of the larger amount of manure alone, as compared with the lesser amount of manure and potash.

VIII. — To determine the economic result of using in rotation on grass lands, the first year, barnyard manure, 8,000 pounds per acre; the second year, wood ashes, 1 ton per acre; and the third year, bone meal, 600, and muriate of potash, 200, pounds per acre. The average yield of hay during the past season, all three systems of manuring being represented on a total area of about 9 acres, is at the rate of 8,050 pounds of hay per acre. The average for the twelve years during which the experiment has continued (1893 to 1904, inclusive) is 6,718 pounds.

IX. — To determine which is better economy, — to spread manure as hauled from the stable during the winter, or to place in a large heap to be spread in spring. This experiment was repeated in five pairs of plots. The winter application gave the better yield in three cases, the spring application in two; but the difference in the value of the crop where the spring application gave the larger yield was not sufficient to cover the difference in the cost of the two systems of handling the manure, which amounts to $4.80 per acre. The winter of 1903 and 1904 was exceptionally favorable to good results from application at that season, as conditions were such that there was no washing over the surface.

X. — To determine whether the application of nitrate of soda after the harvesting of the first crop will give a profitable increase in the rowen crop. The increases produced were considerable, but, possibly because of somewhat deficient rainfall, were not sufficient to make the application distinctly profitable.

XI. — The variety test of potatoes. Forty-nine varieties of potatoes were tested. The yield obtained from the different varieties ranged from 104 bushels of merchantable potatoes per acre for the Clinton to 319 bushels of merchantable potatoes per acre for Simmon's Model. Seven varieties gave a yield in excess of the rate of 260 bushels per acre, namely: Simmon's Model, Extra Early White Rose, Great Divide, Steuben, 1904, Mills' New Rose Beauty. These varieties are mentioned in the order of their productiveness.

XII. — Comparison of different foods and combinations of foods furnishing essential nutrients in different nutritive ratios for laying hens. The hens were supported, at a cost of about 1/6 of a cent per hen daily, on mixtures of food rich in corn, as compared with a cost of about 1/4 of a cent per hen daily, on mixtures of food rich in wheat. The food cost per egg was lowest on the food mixtures containing a large proportion of corn. The combination of feeds including a considerable portion of rice and rice meal gave the most satisfactory egg yield of any combination tested, but the cost of rice is too great to make it an economical food for poultry.

I. — MANURES AND FERTILIZERS FURNISHING NITROGEN COMPARED. (FIELD A.)

The experiments in Field A have two principal objects in view: first, to compare the efficiency (as measured by crop production) of a few standard materials which may be used on the farm as sources of nitrogen; second, to determine to what extent the introduction of a legume will render the application of nitrogen to a succeeding crop of another family unnecessary. The field includes eleven plots of one-tenth acre each. A full description of the plan followed will be found in the twelfth annual report of the Hatch Experiment Station. The materials furnishing nitrogen under comparison are barnyard manure, nitrate of soda, sulfate of ammonia and dried blood. With few and unimportant exceptions, each plot has been manured in the same way since 1890. All the plots annually receive equal and liberal amounts of materials supplying phosphoric acid and potash. Three plots in the field have had no nitrogen applied to them since 1884; the materials under comparison on the other plots in the field are applied in such quantities as to furnish nitrogen at the rate of 45 pounds per acre to each. Barnyard manure is applied to one plot, nitrate of soda to two, sulfate of ammonia to three and dried blood to two plots. The potash applied to these plots is supplied in the form of muriate to six plots, namely, 1, 3, 6, 7, 8 and 9. It is supplied in the form of low-grade sulfate to four plots, namely, 2, 4, 5 and 10. The crops grown in this experiment previous to this year in the order of their succession have been: oats, rye, soy beans, oats, soy beans, oats, soy beans, oats, oats, clover, potatoes, soy beans, potatoes, soy beans.

The crop of this year was potatoes. The variety was the Green Mountain. The seed, which was of fine quality, was grown in northern Maine. The land was plowed on May

3; manure and fertilizers were applied on the 7th, and the potatoes, which had been soaked in formalin solution for prevention of scab, were planted on May 11. The crop was thoroughly cared for throughout the season, although there was some injury from bugs, apparently due to the fact that the Paris green used for the first spraying on June 27 was impure. The vines were sprayed three times with Bordeaux mixture and Paris green: respectively, July 3, 18 and 30. There was apparently little injury from blight. The leaves on the plot to which manure was applied retained their green color considerably longer than those on the other plots. On September 10 they were estimated to be still about one-half green, while the proportion still remaining green on other plots was in general estimated to be about one-tenth to one-eighth. By September 22 the tops were dead, and the potatoes were dug between that date and the 29th. The rates of yield on the several plots and the source of nitrogen on each are shown in the following table: —

Yield of Potatoes per Acre (Bushels).

Plots.	NITROGEN FERTILIZERS USED.	Merchantable.	Small.
0,	Barnyard manure,	236.67	41.67
1,	Nitrate of soda (muriate of potash),	190.33	36.00
2,	Nitrate of soda (sulfate of potash),	188.17	33.50
3,	Dried blood (muriate of potash),	141.83	36.00
4,	No nitrogen (sulfate of potash),	96.33	30.00
5,	Sulfate of ammonia (sulfate of potash),	157.50	19.17
6,	Sulfate of ammonia (muriate of potash),	102.50	13.33
7,	No nitrogen (muriate of potash),	104.33	11.50
8,	Sulfate of ammonia (muriate of potash),	113.50	32.50
9,	No nitrogen (muriate of potash),	141.67	36.17
10,	Dried blood (sulfate of potash),	232.33	24.17

The yield on the different plots varies widely, that on the plot receiving manure being the best in the field, and standing relatively much higher as compared with the plots receiving their nitrogen in the form of a fertilizer than in any previous year. It is believed that this result must be in large measure a consequence of the fact that the application of barnyard manure tends to maintain the stock of humus in the soil, and so keeps it in a condition more favorable to productive capacity. Neither the soy bean nor the potato leaves a residue which contributes materially to the humus content of the soil, and no other crops have been grown during the past five years. Experiments in continuous potato culture without manures in the Cornell University Experiment Station have shown in a striking manner the dependence of this crop upon the presence of a suitable proportion of organic matter in the soil.[1] The common observation that potatoes thrive exceptionally well in virgin soils and upon sod land points in the same direction.

The superiority of the yield on Plot 10 also is striking. This, in the writer's opinion, is due to the fact that the potatoes on this plot were covered by hand, while those on the other plots were covered by the use of the plow. The potatoes on this plot came up much more quickly and more vigorously than those on the others, and showed decided superiority in growth from the start.

The average yields of this year on the several fertilizers are shown in the following table: —

FERTILIZERS USED.	Merchantable (Bushels).	Small (Bushels).
Average of the no-nitrogen plots (3), ...	114.11	25.89
Average of the nitrate of soda plots (2), ...	189.25	34.75
Average of the dried blood plots (2), ...	186.83	30.09
Average of the sulfate of ammonia plots (3), . . .	124.50	21.67

As the result of all experiments previous to this year, it is found that the materials furnishing nitrogen have produced crops in the following relative amounts: —

	Per Cent.
Nitrate of soda, ...	100.00
Barnyard manure, ...	94.00
Dried blood, ...	90.40
Sulfate of ammonia, ...	90.30
No nitrogen, ...	72.80

Similar averages for this year are as follows: —

	Per Cent.
Nitrate of soda, ...	100.00
Barnyard manure, ...	124.30
Dried blood, ...	96.80
Sulfate of ammonia, ...	65.30
No nitrogen, ...	62.50

As was the case last year, the nitrate of soda stands relatively lower than in experiments of previous years, although it still maintains its superiority as compared with the other fertilizers furnishing nitrogen. The barnyard manure produces a superior crop, not, it is believed, because of the superior availability of the nitrogen it contains, but, as has been suggested, because of the better physical condition of the soil produced by the humus it furnishes.

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[1] Bulletin No. 196, Cornell University Experiment Station, p. 52.

If we compare the different materials used as sources of nitrogen on the basis of increase in crop rather than on the basis of total product, they rank to date for the entire period of the experiment 1890 to 1904 as follows: —

Relative Increases in Yields (Average for the Fifteen Years).

	Per Cent.
Nitrate of soda,	100.00
Barnyard manure,	83.60
Dried blood,	66.90
Sulfate of ammonia,	59.90

These figures make the superiority of nitrate of soda as a source of fertilizer nitrogen very apparent. In view of the fact that at current prices it furnishes a pound of nitrogen at a lower cost than almost any other material, the advisability of depending chiefly upon the nitrate as a means of supplying the important element nitrogen becomes strikingly evident.

Effect of a Legume upon the Following Crop.

It is pointed out, in introducing what will be said under this topic, that the object in this experiment is not to test the effect of producing a legume which is plowed under, but simply the improvement, if any, derived from the roots and stubble the legume leaves behind when harvested. The results thus far indicate little improvement in the condition of the soil following the culture of the soy bean, with the exception of those obtained with the potato crop following soy beans in 1902. The introduction of the clover crop, on the other hand, was followed by marked improvement; and it would now appear possible that the good results with the potato crop in 1902 may have been in part at least a consequence of the unexhausted residue of the clover stubble and roots turned under in the spring of 1900. The following table, with the curve below it, makes the facts clear: —

Effect of Leguminous Crops upon the Following Crop (Pounds).

PLOTS (EACH ONE-TENTH ACRE).	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.
	Oats.	Rye.	Soy Bean.	Oats.	Soy Bean.	Oats.	Soy Bean.	Oats.
Nitrogen plots, . .	343	484	1,965	598	620	494	1,740	445
No-nitrogen plots, .	290	421	1,448	540	452	370	1,143	197

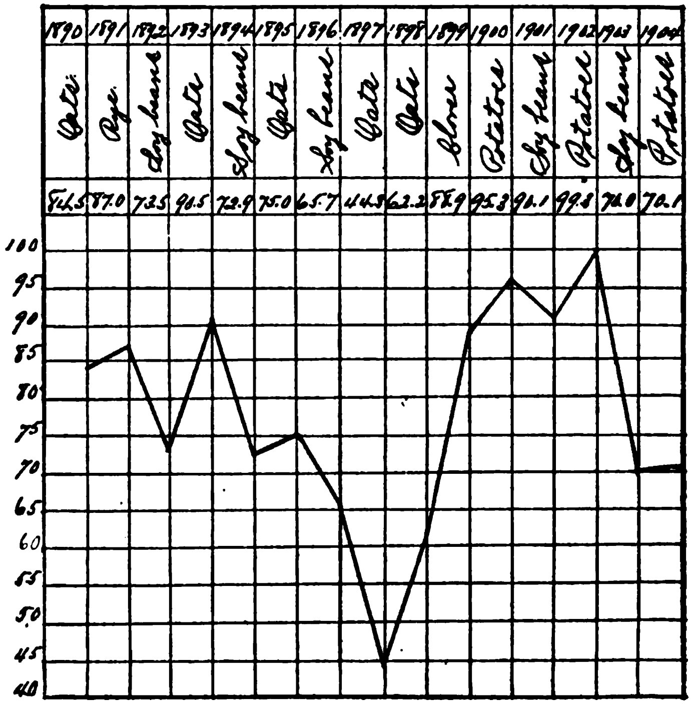
Effect of Leguminous Crops upon the Following Crop (Pounds) — Concluded.

PLOTS (EACH ONE-TENTH ACRE).	1898.	1899.	1900.	1901.	1902.	1903.	1904.
	Oats.	Clover.	Potatoes.	Soy Bean.	Potatoes.	Soy Bean.	Potatoes.
Nitrogen plots, . .	254	413	1,316	442.2[1]	1,053.6	2,726	1,199
No-nitrogen plots, .	158	367	1,254	398.3[1]	1,046.0	1,907	840

[1] Dry beans and straw.

Curve showing Relation of Average No-nitrogen to Average Nitrogen Plots, the Latter being considered in Each Year 100.

[Per cent. average no-nitrogen to average nitrogen.]



It will be noticed that the crops following soy beans have as a rule showed little improvement which can be attributed to that crop. So long as the soy bean was the legume grown, the crops on the no-nitrogen plots continued in general to decline, as compared with the crops obtained upon the nitrogen plots. This is indicated by the fairly uniform and comparatively rapid fall in the line indicating the relative production. The introduction of clover causes a marked rise in the line indicating production, and this continues during the first three seasons following the plowing of the clover sod. The effect of the soy beans upon the crop of potatoes grown in 1902 appears to have been distinctly beneficial; but, as was stated in the fifteenth annual report, the fact that the potato crop in 1902 suffered from blight undoubtedly favored the plots where the growth was relatively feeble. In commenting upon the results obtained in 1902, I said: —

> It may be that the relative standing of the no-nitrogen plots is higher than it would have been had the crop of potatoes grown to normal maturity. It will be remembered that blight and rot prevailed to a considerable extent, and these would naturally injure the potatoes with the ranker growth more than those where the growth was less luxuriant. It does not seem, therefore, that we are justified in concluding that the aftereffect of the soy beans is as useful as the relation between the figures appears to indicate.

In view, then, of the doubt as to whether the true relative capacity for product was shown in 1902, and the further fact that all other years show a general agreement in not indicating a decided benefit following the introduction of the soy bean as a crop, we seem to be justified in the conclusion that the residual fertility left behind by the soy bean is comparatively unimportant.

II. — THE RELATIVE VALUE OF MURIATE AND HIGH-GRADE SULFATE OF POTASH. (FIELD B.)

The object in view in this experiment is to test the relative value of muriate and high-grade sulfate of potash when used continuously upon the same soil. The experiment was begun in 1892. The potash salts were used for the period from 1892 to 1899 inclusive, at the rate of 400 pounds per acre; since 1900 the rate of application has been 250 pounds per acre. Fine-ground bone at the rate of 600 pounds per acre has been yearly applied to all plots. The number of plots in the field at present is ten, five receiving muriate of potash, and alternating with the same number of plots which yearly receive sulfate of potash. Various crops have been grown in rotation, including potatoes, field corn, sweet corn, grasses, oats and vetch, barley and vetch, winter rye, clovers of various kinds, sugar beets, soy beans, and cabbages. Most of these crops have been grown during several years. With few exceptions, good yields have been obtained. Among the crops grown, the potatoes, clovers, cabbages and soy beans have usually done best on sulfate of potash. The yield of corn, grasses, oats, barley, vetches and sugar beets has been about equally good on the two salts, while the quality of the potatoes and sugar beets when grown on sulfate of potash has been distinctly better than on muriate of potash. Three years ago, two of the plots in this field were set to small fruits, asparagus and rhubarb, — on each plot one row each of raspberries, blackberries, asparagus and rhubarb. Aside from the crops just named, those of the past year have been cabbages on two plots and three varieties of clover, namely, Mammoth Red, Medium Red and Alsike, each on two plots. The clover was sown in the spring, and the product of the plots was considerably mixed with weeds; for this reason, the weights were not taken. There was no readily distinguishable difference in the growth of either the Medium or the Mammoth clovers that could be attributed to the difference in potash manuring. The Alsike clover upon the plot manured with sulfate of potash has made a distinctly better start than that on the muriate. Neither the asparagus, raspberries nor blackberries have yet become sufficiently established to give a full crop, and the results will not be reported in detail. The yield of asparagus was substantially equal on the two potash salts. The yield of raspberries on the muriate of potash was considerably greater than on the sulfate. Observation of the growth of the berry bushes and asparagus since they were set indicates that the rate of manuring which has been the practice on this field does not maintain the soil in sufficiently high fertility to produce satisfactory growth on either of the combinations of fertilizers employed. During the past season, therefore, we have used nitrate of soda at the rate of 200 pounds per acre, in connection with the customary amounts of bone meal and potash, on the plots occupied by these crops.

1. *Rhubarb* (*Sulfate v. Muriate of Potash*).

The rhubarb grown in this experiment is of the Monarch variety. The growth has been vigorous and healthy. The product of this year is shown in the following table: —

Muriate v. High-grade Sulfate of Potash (*Rhubarb*). — *Yields per Acre* (*Pounds*).

FERTILIZERS USED.	Stalks.	Leaves.
Muriate of potash,	8,421	11,957
Sulfate of potash,	8,559	14,286

The yield of stalks on the two plots is substantially equal, but the weight of the leaves accompanying the stalks produced on the sulfate of potash is materially greater than on the other potash salt. Whether this fact has any special significance is not at present known; but it is at least suggestive that on Field C, where, under conditions otherwise differing quite widely from those in Field B, the muriate is compared with the sulfate, a similar difference in weight of leaves as compared with stalks is found. It is, of course, evident that the results of this year do not throw any important light upon the question as to whether there is any important practical difference in the two potash salts for this crop.

2. *Cabbages* (*Sulfate v. Muriate of Potash*).

The variety of cabbages grown this year was Fottler's Brunswick Drumhead. The seed was planted in hills two feet apart and in rows three and one-half feet apart, on June 30. The plants were thinned first to two in a hill, and later, on August 16, to one. The summer and the autumn, especially the latter, averaged much below the normal temperature, and the cabbages were by no means matured on the approach of weather which compelled their harvesting. With a normal season there is no doubt that nearly all the plants would have produced merchantable heads. Under existing conditions a very large proportion of the heads were regarded as too soft to be included in that class. The yields per acre are shown in the following table: —

Muriate v. High-grade Sulfate of Potash (*Cabbages*). — *Yields per Acre* (*Pounds*).

FERTILIZERS USED.	Hard Heads.	Soft Heads.
Muriate of potash, ...	872	22,791
Sulfate of potash, ...	2,071	24,319

It will be seen that the product on the sulfate of potash is considerably superior to that on the muriate. The yield of hard heads is nearly two and one-half times as great, while the yield of soft heads also somewhat exceeds that on the muriate. As this result is in general agreement with that usually obtained heretofore with the cabbage crop, it tends to still further confirm the conclusion that it is best that the potash used for this crop be in the form of sulfate rather than muriate.

III. — COMPARISON OF DIFFERENT POTASH SALTS FOR FIELD CROPS. (FIELD G.)

Field G contains 40 plots, of about one-fortieth of an acre each. The experiments in progress have for their object the determination of the relative value for field crops of all the prominent potash salts when each is used continuously upon the same land throughout a long series of years. This experiment was begun in 1898. The plots are arranged in five series of eight each. In each series one plot has received no potash since the experiment began. The potash salts under trial are as follows: kainit, high-grade sulfate of potash, low-grade sulfate of potash, muriate of potash, nitrate of potash, carbonate of potash and silicate of potash. Each is always applied in such quantity as to furnish actual potash at the rate of 165 pounds per acre. All the plots in the field are yearly fertilized with materials supplying to each equal amounts of nitrogen and phosphoric acid. For nitrogen, nitrate of soda is applied at the rate of 250 pounds per acre, except on the plots where nitrate of potash is the source of the potash applied; here a suitable reduction in the quantity of nitrate of soda is made, on account of the nitrate nitrogen furnished by the potash salt. The principal source of phosphoric acid on these plots is acid phosphate, applied at the rate of 360 pounds per acre to all. Tankage at the rate of 270 pounds per acre is applied to all plots as a source of less immediately available nitrogen and phosphoric acid. The crops grown in this experiment in the order of succession are as follows: 1898, Medium Green soy beans; 1899, Beauty of Hebron potatoes; 1900, Fottler's Brunswick cabbage, Medium Green soy beans, Black cow pea, Wonderful cow pea; 1901, Turkish Red wheat, Medium Red clover; Rural Thoroughbred, Leaming Field, Boston Market and Eureka corn; 1902, Medium Red clover; 1903, Medium Red clover.

During the past season the crops grown in the field were as follows: cabbages on sixteen plots, two series of eight each; Sibley's Pride of the North corn on sixteen plots, two series; and Leaming Field corn for ensilage on eight plots. The season was unfavorable to full maturity for the cabbage crop, for reasons which have been alluded to in discussing results on fields B and C. For the same reasons, and also because of the excessive rains at the season of planting, the season was highly unfavorable to the corn crop. Defective germination, owing to the excessive rains, produced an uneven stand of plants in the areas devoted to corn. For the reasons indicated, it does not seem worth while to publish the results in full detail, and averages only will be given. These for the cabbages are as follows: —

Cabbages. — Average Rates of Yield per Acre (Pounds).

POTASH SALT.	Hard Heads.	Soft Heads.
No potash (plots 1, 9),	10,850	22,850
Kainit (plots 2, 10),	11,100	26,150
High-grade sulfate (plots 3, 11),	10,600	25,500
Low-grade sulfate (plots 4, 12),	12,100	27,400
Muriate of potash (plots 5, 13),	11,900	26,600
Nitrate of potash (plots 6, 14),	14,800	23,100
Carbonate of potash (plots 7, 15),	16,500	23,400
Silicate of potash (plots 8, 16),	10,650	25,050

The most striking points brought out by these figures are: first, the high-grade sulfate of potash fails to show the superiority in yield to muriate which has generally been shown; second, the nitrate and carbonate of potash have given yields very materially exceeding those obtained on any of the other potash salts; third, the yield on the silicate of potash is one of the poorest in the field.

Field Corn.—Average Yields per Acre.

POTASH SALT.	Sound Corn (Bushels).	Soft Corn (Bushels).	Stover (Pounds).
No potash (plots 17, 25),	15.00	17.78	3,740
Kainit (plots 18, 26),	20.25	14.00	4,300
High-grade sulfate (plots 19, 27),	19.50	13.45	4,340
Low-grade sulfate (plots 20, 28),	17.75	14.34	4,200
Muriate of potash (plots 21, 29),	20.50	14.44	4,660
Nitrate of potash (plots 22, 30),	17.00	13.45	4,020
Carbonate of potash (plots 23, 31),	17.00	15.78	4,420
Silicate of potash (plots 24, 32),	13.75	18.56	4,160

The most striking point brought out by these averages is the poor results where the silicate is the potash salt employed. Aside from this, the results with corn seem to be in general accord with those which have been usually obtained, which indicate that the different potash salts appear to have substantially similar effects upon this crop.

Ensilage Corn.—Average Yield per Acre (Pounds).

POTASH SALT.	Green Fodder.	POTASH SALT.	Green Fodder.
No potash (plot 33),	28,800	Muriate (plot 37),	36,800
Kainit (plot 34),	38,800	Nitrate (plot 38),	32,800
High-grade sulfate (plot 35),	34,600	Carbonate (plot 39),	30,000
Low-grade sulfate (plot 36),	36,600	Silicate (plot 40),	22,400

In the case of the ensilage, as well as field corn, the silicate of potash gives a yield much inferior to that produced by the other potash salts. That the silicate, whether with cabbages, field or ensilage corn in each of the five series of plots where it is employed, gives yields inferior to those obtained with the other potash salts, and that the yield does not in some cases equal even the yield obtained from the no-potash plot, is a fact which it seems desirable to point out. Up to the present year the yields on silicate of potash with the different crops grown have not been markedly inferior to those obtained on other potash salts. It is impossible, in the light of our present knowledge of the conditions, to offer an explanation of the facts, although it is, of course, evident that the soil, which was originally in fair condition as regards its stock of available potash, has previous to this year been in condition to furnish a larger share of the potash needed by the crop than at present. With increasing exhaustion of natural stores of potash, the differences due to the several fertilizers used may naturally be expected to increase.

IV. — COMPARISON OF PHOSPHATES ON THE BASIS OF EQUAL APPLICATION OF PHOSPHORIC ACID.

The present is the eighth season of this experiment, which has for its object the determination as measured by crop production, of the relative availability of different materials which may be used as sources of phosphoric acid when used in such quantities as to furnish equal amounts of actual phosphoric acid to each plot, and in connection with materials which supply the other elements of plant food, especially the nitrogen and the potash, in abundance and in the same forms and in equal amounts on each of the plots. The field in which these experiments are carried on is divided into thirteen plots, of about one-eighth of an acre each. Three plots in the field, one at each end and one in the middle, have received no phosphoric acid since the experiment began. The phosphates which are employed on the other plots are as follows: apatite, South Carolina rock phosphate (fine ground), Florida soft phosphate, basic slag meal, Tennessee rock phosphate (fine ground), dissolved bone-black, raw bone meal, dissolved bone meal, steamed bone meal and acid phosphate. These phosphates are used in such quantities as to furnish actual phosphoric acid, at the rate of 96 pounds per acre. The nitrogen and potash fertilizers used supply nitrogen at the rate of 52 pounds and potash at the rate of 152 pounds per acre. With some of the crops grown (onions and cabbages) a supplementary application of quick-acting nitrogen fertilizers has been made to all plots alike. The crops which have been grown in the field during the progress of the experiment are as follows: corn, cabbages, corn, in 1900 two crops, — oats and Hungarian grass (both for hay), onions, onions, and cabbages. With the exception of the onions and cabbages, all the crops previously grown in the field have given good yields, even on the three no-phosphate plots. The soil of the different parts of the field was not even in fertility at the start. Plot 1 was somewhat more productive than any of the others, and in general the plots tended to decline in productiveness from 1 toward 13. The crop the past season was corn. The soil of the field inclines to be heavy, and the corn crop during the prevailing cool weather of the past season suffered from poor soil conditions and low temperature, especially on plots 8, 11, 12 and 13. Observation of the growth of the crop of the preceding year (cabbages), and study of the soil conditions throughout the preceding season, had led to the conclusion that the physical and chemical conditions of the soil in the field would be improved by a heavy application of lime. The field was plowed in the fall of 1903. Freshly slacked lime to the amount of 4,675 pounds (about 2,000 pounds per acre) was applied on May 10 and plowed in on May 15. The variety of corn grown was the Leaming Field. The seed was obtained of E. E. Chester & Son, Champaign, Ill., and was of excellent quality. The rainfall was so excessive, however, that there were a few blanks in some of the plots. The crop was cut on September 19 and immediately weighed and put into the silo. The rates of the yields on the several plots are shown in the following table: —

Plots.	FERTILIZERS USED.	Green Corn (Pounds per Acre).
1, ...	No phosphate, ...	41,000
2, ...	Apatite, ...	40,720
3, ...	South Carolina rock phosphate, ...	40,496
4, ...	Florida soft phosphate, ...	28,240
5, ...	Phosphatic slag, ...	36,440
6, ...	Tennessee phosphate, ...	32,120
7, ...	No phosphate, ...	32,344
8, ...	Dissolved bone-black, ...	30,080
9, ...	Raw bone, ...	45,800
10, ...	Dissolved bone meal, ...	41,840
11, ...	Steamed bone meal, ...	28,400
12, ...	Acid phosphate, ...	29,040
13, ...	No phosphate, ...	20,240

The point of principal significance in connection with the results appears to be the marked inferiority of the yield on the Florida soft phosphate. There was no difference in the physical conditions on this plot, as compared with those on either side, that can explain the wide difference in the amount of the product. The results of this year, then, additionally confirm the conclusions of previous years, — that this phosphate seems likely to give results which are distinctly disappointing, as compared with the claims of those interested in its production and sale. The low product on plots 8, 11 and 12 was undoubtedly in considerable measure due to the unfavorable conditions which have been referred to.

V. — Soil Tests.

In introducing what I have to say concerning soil tests, I cannot do better than to employ the language used in my last annual report, p. 244: —

> Two soil tests, both upon our own grounds and both in continuation of previous work upon the same fields, have been carried out during the past season. Fertilizers have been applied in accordance with the co-operative plan for soil tests, with one or two small exceptions. Lime and plaster have been applied to the plots calling for these fertilizers in double the usual soil test amounts. Each plot annually receives an application of the same kind or kinds of fertilizers. Such experiments are not adapted to securing the production of heavy crops. By study of the results, the effects of the different leading elements of plant food on the several crops can be determined with much accuracy.
>
> Every fertilizer used, whether applied by itself or in connection with one or both of the other fertilizer materials, is always applied in the same quantities. Both fertilizers and manure (where the latter is introduced for purposes of comparison) are always applied broadcast after plowing, and harrowed in. The kinds and the amounts per acre are as follows: —
>
> Nitrate of soda, 160 pounds, furnishing nitrogen.
> Dissolved bone-black, 320 pounds, furnishing phosphoric acid.
> Muriate of potash, 160 pounds, furnishing potash.
> Land plaster, 400 pounds.
> Lime, 800 pounds.
> Manure, 5 cords.

A. — Soil Test with Corn (South Acre).

This acre has been used in soil tests for sixteen years, beginning in 1889. The crops for successive years have been as follows: corn, corn, oats, grass and clover, grass and clover, corn (followed by mustard as a catch crop), rye, soy beans, white mustard, corn, corn, grass and clover, grass and clover, corn, corn, and corn. Since 1889 this field has, therefore, borne eight corn crops, and during this time it has been four years in grass. The present is the third successive corn crop, these three crops following grass, which occupied the field in 1901. Last season was one of the most unfavorable for corn within the memory of our oldest men. The crop was exceedingly small, even on the land which had annually received an application of manure at the rate of 5 cords per acre. With only one exception, previous to last year, the corn crop wherever potash has been applied to the soil in this field has always been good. In 1898 the crop even where potash and other fertilizers had been used was small. This suggested the probable necessity of an addition of lime. The application of lime at the rate of 1 ton to the acre restored the productiveness of all the plots to which muriate of potash had been continuously applied. The small crop of last year, in connection with observations on the condition of the soil, led to the conclusion that lime might once more prove useful; the entire field, therefore, was given a dressing of freshly slacked lime, at the rate of 1 ton per acre. The marked increase in the crop of this year wherever potash was used indicates the correctness of the opinion that lime was needed. The plot where potash was used alone last year gave a yield at the rate of about 15.5 bushels of corn per acre; this year the product is almost three times that amount. Last year the plot to which nitrate of soda and muriate of potash are annually applied gave a yield at the rate of 16.5 bushels per acre; this year the yield is 47.8 bushels. The plot receiving dissolved bone-black and muriate of potash, which last year gave a crop of a little less than 19 bushels, this year gave a crop of rather over 53 bushels. These facts make it strikingly evident that, in connection with fairly liberal amounts of muriate of potash, it is essential to use lime freely on many of our soils, if their productiveness is to be maintained. This field contains four plots, to which neither manure nor fertilizer of any kind has been applied during the sixteen years that the experiment has continued. These plots have now become very highly exhausted, producing crops which are practically valueless so far as the production of grain is concerned, although the nominal yield is at the rate of about 3.5 to 8 bushels per acre. The following table shows the fertilizers used on the several plots, the rate of yield, and the gain or loss per acre compared with the nothing plots: —

Corn. — South Acre Soil Test, 1904.

Plots.	FERTILIZERS USED.	YIELD PER ACRE.		GAIN OR LOSS PER ACRE, COMPARED WITH NOTHING PLOTS.	
		Corn (Bushels, 90 Pounds).	Stover (Pounds).	Corn (Bushels, 90 Pounds).	Stover (Pounds).
1, .	Nitrate of soda, ...	7.11	1,200	2.78	330
2, .	Dissolved bone-black, . .	3.89	960	—.44	90
3, .	Nothing, ...	4.33	870	-	-
4, .	Muriate of potash, . . .	46.89	3,760	42.86	2,933
5, .	Lime, ...	2.67	820	—1.07	—37
6, .	Nothing, ...	3.44	740	-	-
7, .	Manure, ...	50.00	4,000	46.56	3,260
8, .	Nitrate of soda and dissolved bone-black.	15.11	1,500	6.33	320
9, .	Nothing, ...	8.78	1,180	-	-
10, .	Nitrate of soda and muriate of potash.	47.67	3,560	39.71	2,440
11, .	Dissolved bone-black and muriate of potash.	53.11	3,940	45.96	2,880
12, .	Nothing, ...	6.33	1,000	-	-
13, .	Plaster, ...	7.44	1,100	1.11	100
14, .	Nitrate of soda, dissolved bone-black and muriate of potash.	47.78	3,700	41.45	2,600

It will at once be noticed that the potash is the element which determines the crop, almost to the exclusion of all others. Where potash has been used alone during sixteen years, the yield is almost as great as it is with potash and any of the other combinations. Nitrate of soda alone does very little good. Dissolved bone-black alone gives a crop less than the average of the nothing plots. The combination of nitrate of soda and dissolved bone-black gives a very inferior crop, but wherever potash is used the crop is good. Particular attention is called, further, to the fact that the continuous use of lime alone is not beneficial; on the contrary, the yield on the plot where lime has been continuously used is the poorest in the field. Plaster used alone and continuously gives a slightly better crop, but not much in excess of the nothing plots. It may perhaps be urged that the soil of this field must be of very exceptional character; that, otherwise, the so long-continued use of one fertilizer element could not produce the results obtained. To a certain extent this criticism may be justified, and I do not call particular attention to the marked effect of the potash for the purpose of urging upon our farmers exclusive dependence upon this fertilizer, but to make more emphatic the point that our farmers in general should insist that fertilizers designed for use for the corn crop should be richer in potash than is usually the case. The results obtained in previous years on this field indicate not so much that this soil is deficient in potash, — for some crops, such as grass, for example, do well on the plots to which no potash has been applied since the beginning of the experiment, — as that the corn crop depends in a marked degree upon a liberal supply of readily available potash.

B. — Soil Test with Mixed Grass and Clover (North Acre).

The acre used in the north soil test has been kept in this experiment fifteen years, beginning in 1890. The fertilizers have been used in the same combinations and in general in the same amounts on the several plots as in the south soil test, except that during the years when onions have been grown the fertilizers have been used in double the usual quantities. Each fertilizer or combination of fertilizers has been used continuously upon the same plot. In this experiment the plots were divided transversely in 1899, and lime was applied at the rate of 1 ton to the acre to one-half of each plot. The lime was applied after plowing, and harrowed in. During the past season the same halves of all the plots have once more been limed, and at practically the same rate as before; but this year, as the land was in grass, the lime was applied as a top-dressing on the grass in spring. The date of application was May 13. The crops grown in this field, in the order of succession, beginning in 1890, have been: potatoes, corn, soy beans, oats, grass and clover, grass and clover, cabbages and ruta-baga turnips, potatoes, onions for four years (1898 to 1901 inclusive), potatoes, grass and clover, and grass and clover. The field was sown to grass and clover after the harvesting of potatoes in the autumn of 1902 (September 15). The rate of seeding per acre was: timothy, 18 pounds; red-top, 8 pounds; red clover, 5 pounds; and alsike clover, 4 pounds. The clover winter-killed, and accordingly additional clover seed (15 pounds) was sown on April 4, 1903.

On account of the deficiency in rainfall from the middle of April to about the 10th of June, 1903, the yields last year on all plots were very small. The yields during the past season have been much larger. They are shown in the following table: —

Grass and Clover. — North Acre Soil Test, 1904.

Plots.	Fertilizers used.	Yield per Acre, Hay.		Gain or Loss per Acre, compared with Nothing Plots.	
		Unlimed (Pounds).	Limed (Pounds).	Unlimed (Pounds).	Limed (Pounds).
1, .	Nothing, ...	1,060	800	-	-
2, .	Nitrate of soda, ...	1,960	1,600	1,067	880
3, .	Dissolved bone-black, . .	1,000	680	273	40
4, .	Nothing, ...	560	560	-	-
5, .	Muriate of potash, . . .	600	1,920	40	1,265
6, .	Nitrate of soda and dissolved bone-black.	2,120	2,820	1,560	1,570
7, .	Nitrate of soda and muriate of potash.	1,920	1,860	1,360	1,015
8, .	Nothing, ...	560	940	-	-
9, .	Dissolved bone-black and muriate of potash.	860	3,600	280	2,575
10, .	Nitrate of soda, dissolved bone-black and muriate of potash.	2,200	4,400	1,600	3,290
11, .	Plaster, ...	560	600	—60	—595
12, .	Nothing, ...	640	1,280	-	-

Grass and Clover.—North Acre Soil Test, 1904—Concluded.

Plots.	FERTILIZERS USED.	YIELD PER ACRE, ROWEN.		GAIN OR LOSS PER ACRE, COMPARED WITH NOTHING PLOTS.	
		Unlimed (Pounds).	Limed (Pounds).	Unlimed (Pounds).	Limed (Pounds).
1, .	Nothing, ...	140	80	-	-
2, .	Nitrate of soda, ...	60	90	—30	7
3, .	Dissolved bone-black, . .	60	120	30	7
4, .	Nothing, ...	30	130	-	-
5, .	Muriate of potash, . . .	70	780	37	557
6, .	Nitrate of soda and dissolved bone-black.	210	810	175	495
7, .	Nitrate of soda and muriate of potash.	50	520	12	112
8, .	Nothing, ...	40	500	-	-
9, .	Dissolved bone-black and muriate of potash.	80	2,560	47	2,125
10, .	Nitrate of soda, dissolved bone-black and muriate of potash.	620	2,840	595	2,470
11, .	Plaster, ...	20	80	2	—225
12, .	Nothing, ...	10	240	-	-

The results of this year resemble those of last year in one particular, namely, the marked increase in the first crop which follows the application of nitrate of soda; but in one important particular the results this year differ from those of 1903 in a marked degree, namely, in the very large increase on the limed portion of those plots to which muriate of potash has been annually applied. In commenting upon the results of last year, I said:— .

> Much evidence is afforded by a study of the relative proportions of the different species on the different plots and on the limed and unlimed portions of the several plots, that the soil in some parts of this field is once more becoming acid.

The principal ground on which this statement was based was the comparative absence of clover, even on the limed portion of such plots as had been supplied annually with potash. This relative absence of clover last year was doubtless in part due to the unfavorable climatic conditions; but the widely different results of this year indicate that the lime applied this season proved distinctly and largely beneficial.

It is desired to call particular attention to the yield both of hay and of rowen on the limed portion of Plot 9. This plot, it should be understood, has not received an application of anything furnishing nitrogen during the fifteen years that the experiment has continued; and yet on the limed portion of this plot we this year have a yièld of hay at the rate of 3,600 pounds and a yield of rowen at the rate of 2,560 pounds per acre, — a total of rather over 3 tons, at a fertilizer cost at the rate of $6.50 per acre. Allowing for an application of lime at the rate of a ton once in eight years, the annual cost of the materials applied to this plot amounts to about $7.50 per acre. The yields obtained at this very low cost indicate in a most striking manner the possibilities in the production of clover hay on soils naturally suited to clovers, without the use of the expensive nitrogen manures or fertilizers.

It is of especial interest to compare the yields of Plot 10 with those on Plot 9. Plot 10 has annually received nitrate of soda, in addition to the same amounts of dissolved bone-black and muriate of potash as are used on Plot 9. The result is a fair hay crop, even on the part of the plot where lime has not been used. Here, however, as on Plot 9, the yield is greatly increased by the application of lime, and we have a total in the two crops of the year at the rate of 7,240 pounds per acre. This exceeds the yield of the two crops on Plot 9 at the rate of a little more than a thousand pounds per acre. This increase is produced as the result of an application at the rate of 160 pounds of nitrate of soda. Such an application would cost about $4, and the increase is therefore produced at a moderate profit.

As in previous years, the relative proportion of the different species (red-top, timothy and clovers) on the several plots has been carefully studied. The most important points noted are as follows: first, the use of nitrate of soda increases the proportion of red-top; second, potash increases the proportion of clover in a marked degree, and this influence is enormously increased on the limed portion of the plots.

It will be seen, by reference to the table showing how the fertilizers are applied, that Plot 6, which receives an application of nitrate of soda and dissolved bone-black annually, lies between two plots (5 and 7) each of which annually receives an application of potash. During the past season, and to some slight extent in previous seasons, it has been noticed that the growth of the crops on the edges of Plot 6, although it is separated from 5 and 7 by strips 3½ feet in width which have not received any fertilizer since the experiment began, shows plainly the influence of the potash applied to the neighboring plots, which has apparently diffused through the intervening 3½ feet strips, and is now beginning to affect the growth of the crops on Plot 6. During the past season there has been a little fringe of clover on each edge of Plot 6; this, however, has not been sufficient in amount to materially affect the yield on this plot, which, as will be seen, showed but little increase in the amount of rowen, which best measures the proportion of clover. The figures, however, for this plot are undoubtedly to some small degree misleading. The nitrate and the dissolved bone-black alone would produce little or no clover; they have, however, produced a fairly large crop of hay, about equally good on the unlimed and limed portions of the plot. This result is doubtless to be ascribed mainly to the effect of nitrate of soda in stimulating the growth of the grasses.

The relatively small increase on the limed portion of Plot 7, where nitrate of soda and muriate of potash are used together, appears to be due to the fact referred to in my last annual report, — that, where these two fertilizers are used together, soil effects very unfavorable to the growth of clover follow. It is believed that, to correct this unfavorable influence of these chemicals, lime must be used in very large amounts.

VI. — SPECIAL CORN FERTILIZER *v.* FERTILIZER RICHER IN POTASH.

It may be remembered that on this acre we are endeavoring to throw light upon the question as to the proper composition of fertilizers used alone for the corn crop. This experiment began in 1891. The crop from 1891 to 1896 inclusive was corn; in 1897 and 1898 the crop was mixed grass and clover; in 1899 and 1900 it was corn; in 1901 and 1902, grass and clover; in 1903 and 1904, corn. A statement of the results to date will be found in preceding annual reports. The object in view is to test the question as to whether the special corn fertilizers offered in our markets are of such composition as is best suited for the production of corn in rotation with mixed grass and clover. The field used in the experiment contains one acre, and is divided into four equal plots. Plots 1 and 3 have yearly received an application of mixed fertilizers, furnishing the same amount of nitrogen, phosphoric acid and potash as would be furnished by 1,800 pounds of fertilizer of the composition of the average of the special corn fertilizers analyzed at this station. This average has changed but little during recent years, and in 1899, since which date we have made no change in the kinds and amounts of fertilizers used, was as follows: —

	Per Cent.
Nitrogen,	2.37
Phosphoric acid,	10.00
Potash,	4.30

The various fertilizers offered in 1899 differed widely in composition. The extent of the variation is shown in the following table: —

	Per Cent.
Nitrogen,	1.5– 3.7
Phosphoric acid,	9.0–13.0
Potash,	1.5– 9.5

The fertilizers used on plots 2 and 4 are substantially the same in kind and amount as recommended in Bulletin No. 58 for corn on soils poor in organic matter. The essential difference in composition between the fertilizer mixtures under comparison is that that used on plots 2 and 4 is richer in potash and much poorer in phosphoric acid than the mixture representing the average market corn fertilizers. The fertilizers applied to the several plots are shown below: —

FERTILIZERS USED.	Plots 1 and 3 (Pounds Each).	Plots 2 and 4 (Pounds Each).
Nitrate of soda,	30.0	50.0
Dried blood,	30.0	–
Dry ground fish,	37.5	50.0
Acid phosphate,	273.0	50.0
Muriate of potash,	37.5	62.5

The crop of the past two seasons has been corn, the crop of 1903 being the first to follow mixed grass and clover, which occupied the land in 1901 and 1902. The season of 1904, while too low in average temperature for the best growth of corn, was distinctly more favorable to the crop than 1903. The following tables show the yields on the several plots and the averages for the two systems of manuring: —

Yields of Corn, 1904.

PLOTS.	Good (Bushels).	Soft (Bushels).	Stover (Pounds).
Plot 1 (lesser potash), ...	59.25	7.78	10,640
Plot 2 (richer in potash), ...	57.50	9.33	9,208
Plot 3 (lesser potash), ...	57.75	7.79	8,280
Plot 4 (richer in potash), ...	55.25	13.56	9,660

Average Yields per Acre.

PLOTS.	Good (Bushels).	Soft (Bushels).	Stover (Pounds).
Plots 1 and 3 (lesser potash), ...	58.50	7.78	9,460
Plots 2 and 4 (richer in potash), ...	56.37	11.45	9,434

It will be seen that the yields under the two systems of fertilization were substantially equal, although the grain on plots 1 and 3 was better ripened than on the other plots. During the early part of the season the growth of the corn on plots 1 and 3 was materially better than on plots 2 and 4; the plants showed a better color and were of larger size. This difference showed itself very early in the season. On July 6, it was judged that the plants on plots 1 and 3 averaged one and one-half times the height of the plants on the other plots, and the difference in the growth on that date was judged to be considerably less than at an earlier period. As the season advanced, the corn on plots 2 and 4 steadily gained in condition and size, as compared with that on plots 1 and 3; and by the end of the season, as the harvest showed, the initial superiority on plots 1 and 3 had entirely disappeared. At present we are not in a position to state to what cause the superior growth on plots 1 and 3 early in the season was due; but it appears probable that the cause was the stimulative effect of the excess of phosphoric acid, which, as has been repeatedly shown, when used in liberal amounts exercises a marked effect in hastening maturity.

At present prices for fertilizer materials, the fertilizers used on plots 1 and 3 cost, laid down in Amherst, at the rate of $19.25 per acre; those used on plots 2 and 4 cost at the rate of $14.20 per acre. The fertilizer combination richer in potash, therefore, costs a little more than $5 per acre less than the combination representing average corn fertilizers. It is significant that at this lower cost we have a corn crop equal to that produced at the higher figure. Last year, when the corn crop on all plots was very poor, the yield on plots 1 and 3 was distinctly better than on plots 2 and 4; but, with that exception, the average results to date show corn crops substantially equal on the two fertilizer combinations, while whenever the land is put into mixed grass and clover, the fertilizer combination richer in potash gives crops materially larger and of better quality than the combination richer in phosphoric acid. The advantage to date, therefore, is most decidedly in favor of the fertilizer combination containing the more potash; and fertilizer manufacturers are urged to increase the proportion of this element in corn fertilizers, and farmers on their part should insist on such increase.

VII. — MANURE ALONE *v.* MANURE AND POTASH.

These experiments, which have for their object to show the relative value as indicated by crop production of an average application of manure used alone, as compared with a smaller application of manure used in connection with a potash salt, were begun in 1890. The field used is level, and the soil of comparatively even quality. It is divided into four quarter-acre plots. The crop grown during the years 1890 to 1896, 1899 and 1900, 1903 and during the past season, has been corn. In 1897 and 1898, and again in 1901 and 1902, the crop was mixed grass and clover. Where manure is used alone, it is applied at the rate of 6 cords per acre. Where manure is used with potash, the rates of application are: manure, 4 cords; high-grade sulfate of potash, 160 pounds per acre. Manure alone is applied to plots 1 and 3; the lesser quantity of manure and high-grade sulfate of potash to plots 2 and 4. Estimating the manure alone as costing $5 per cord, applied to the land, the money difference in the cost of materials applied is at the rate of $5.30 per acre, the manure and potash costing that amount less than the larger quantity of manure alone. The tables show the rates of yield on the several plots, and the averages, under the two systems of manuring.

Yield of Corn, 1904.

PLOTS.	Corn (Bushels).	Stover (Pounds).
Plot 1 (manure alone),	68.25	5,840
Plot 2 (manure and potash),	66.25	5,280
Plot 3 (manure alone),.	66.50	4,280
Plot 4 (manure and potash),	58.25	4,840

Average Yields per Acre.

PLOTS.	Corn (Bushels).	Stover (Pounds).
Plots 1 and 3 (manure alone),	67.37	5,060
Plots 2 and 4 (manure and potash),.	62.25	5,060

The averages made show an equal amount of stover produced under the two systems of manuring, and slightly more than 5 bushels of corn per acre less on the combination of manure and potash than on the larger quantity of manure alone. This difference in yield is not sufficient to pay the added cost of the larger quantity of manure applied to plots 1 and 3; but, since manure is an article of home production on most farms where corn is grown, not much importance would be attached to this point by the average farmer. The corn crops produced under the two systems of manuring previous to this year have been substantially equal. The inferiority in yield this year is of consequence only on Plot 4; and it is suspected that accidental variation in conditions determined the smaller product on this plot, rather than the difference in the system of manuring. We know that the plants in the field, on account of imperfect germination due to the unfavorable weather which preceded and followed planting, were not as thick as is desirable. The fact, however, that the yield of stover on Plot 4 is greater than that on Plot 3, renders it exceedingly doubtful whether the cause of the relatively small yield of corn on Plot 4 was the greater proportion of unoccupied space.

VIII. — EXPERIMENT IN MANURING GRASS LAND.

The report which is to be made concerning results in this experiment is best introduced by quoting from my sixteenth annual report: —

> In this experiment, which has continued since 1893, the purpose is to test a system of using manures in rotation for the production of grass. The area used in the experiment is about nine acres. It is divided into three approximately equal plots. The plan is to apply to each plot one year barnyard manure, the next year wood ashes, and the third year fine ground bone and muriate of potash. As we have three plots, the system of manuring has been so arranged that every year we have a plot illustrating the results of each of the applications under trial. The rates at which the several manures are employed are as follows: barnyard manure, 8 tons; wood ashes, 1 ton; ground bone, 600 pounds and muriate of potash, 200 pounds, per acre. The manure is always applied in the fall, ashes and the bone and potash in early spring.

The past season was exceptionally favorable for the production of a heavy yield of hay, but a relative deficiency in rainfall during the period occupied by the growth of the rowen crop was doubtless the principal reason for the falling off in the yield of rowen, as compared with that produced in the season of 1903. The yields of hay and rowen and the total yields for each system of manuring were at the following rates per acre: —

FERTILIZERS USED.	Hay (Pounds).	Rowen (Pounds).	Totals (Pounds).
Barnyard manure,	7,068	2,147	9,215
Bone and potash,	6,024	2,030	8,054
Wood ashes,	4,866	2,064	6,930

The average total yield of the entire area for this year is 8,050 pounds. The average for the entire period during which the experiment has continued (1893 to 1903 inclusive) is 6,597 pounds. The average to date is 6,718 pounds. The average yield when top-dressed with manure has been 7,026 pounds; when top-dressed with wood ashes, 6,304 pounds; when top-dressed with bone and potash, 6,686 pounds. The yields for the past year, it will be noticed, are considerably above the averages for the entire period.

Different Seed Mixtures compared.

In my last annual report[1] will be found a description of the variation in the seed mixtures used on different portions of two plots in this field (1 and 2). In one of these seed mixtures timothy is the most prominent species; in the other, meadow and tall Fescue are prominent; and these different mixtures may be spoken of respectively as the timothy mixture and the Fescue mixture. The timothy mixture is substantially the same as that in general use among farmers, including timothy, red-top, common red clover and alsike clover. The other mixture includes small quantities of all of these species, and in addition Kentucky blue-grass and the two Fescues named. In my last report the statement is made that it is believed that the Fescues will hold the ground more tenaciously than the timothy. The yields last year were materially greater on the portions of the plots occupied by the timothy mixture. The rates of yield on the two mixtures for the past season are as follows: —

	YIELD PER ACRE (POUNDS).	
	Hay.	Rowen.
Plot 1, Timothy mixture, ...	6,229	2,101
Plot 1, Fescue mixture, ...	5,769	2,121
Plot 2, Timothy mixture, ...	5,541	2,129
Plot 2, Fescue mixture, ...	5,896	2,597

The differences this year are materially less than last, and on Plot 2 the Fescue mixture has given the larger yield.

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[1] Sixteenth annual report, Hatch Experiment Station, pp. 145, 146.

The timothy has not yet been displaced by other species to any noticeable extent, but the poorer showing of the mixture in which it is prominent this year as compared with last possibly indicates that the belief that the Fescue mixture would ultimately prove the better of the two will be justified by the results obtained.

IX. — EXPERIMENT IN THE APPLICATION OF MANURE.

This experiment is designed to ascertain whether it is economically good policy to spread manure during the late fall and winter, and allow it to remain on the surface until spring before plowing under. This system in our experiment is compared with the plan of hauling manure to the field during the winter, and putting it into large heaps. To insure even quality of the manure used in the two systems, it is our practice to manure two plots at one time, putting the loads of manure as hauled to the field alternately upon the two, in the one case spreading, but in the other putting a sufficient number of loads to provide for the entire plot into one large heap. We are using in this experiment five large plots, each of which is subdivided into two subplots. For one of these subplots the manure is spread when hauled out, for the other it is put into a large heap. The area of these subplots is about one quarter of an acre, and to each the amount of manure applied is 11,096 pounds. The manure from well-fed milch cows is used upon eight subplots, and horse manure on two. The manure used in this experiment is applied at different dates during the winter, our practice being to allow the manure to accumulate in the pits from which it is taken until there is a sufficient quantity for at least two subplots. The condition of the soil at the time of application and the nature of the weather which follows must necessarily differ in the different experiments; and these differences, together with the difference in the dates of application above referred to, no doubt in a measure account for the variation in the results of the two systems noticed on the different plots.

The crop in this field last year was soy beans. After the beans were harvested, winter rye was sown as a cover crop.

The date of sowing was necessarily late, and the rye went into the winter very small. There was no injury, however, from winter-killing, and at the date of plowing last spring, May 14, this crop had made considerable growth. The crop of the past season was a mixed growth of Sibley's Pride of the North corn and Medium Green soy beans for ensilage. The corn, on account of seasonal peculiarities several times alluded to in this report, germinated somewhat imperfectly, and there was some damage due to pulling of the young plants by crows. The proportion of corn to beans, therefore, was somewhat lower than is desirable. The date of planting was June 13 and 14, the work having been impossible earlier, on account of the wet condition of the soil. Taking into consideration the condition of the soil at the time of planting and the relatively low temperature of the summer, the crop was fairly satisfactory; but it was undoubtedly unfavorably affected in places because of faulty soil conditions. It was judged that these conditions most seriously affected the several pairs of plots directly compared in the following table as follows: in Plot 1, on the south half; in Plot 2, on the north half; in Plot 3, on the south half; in Plot 4, on the south half; and in Plot 5, on the south half. These facts should be kept in mind in interpreting the results. The rates of yield per acre and the relative standing of the several plots are shown in the following table: —

Actual and Relative Yields of Green Forage. — Corn and Soy Beans.

PLOTS.	ACTUAL YIELDS (RATES PER ACRE, POUNDS).		RELATIVE YIELDS (PER CENT.).	
	North Half, Winter Application.	South Half, Spring Application.	North Half, Winter Application.	South Half, Spring Application.
Plot 1, ...	26,622	24,549	100	92.2
Plot 2, ...	20,548	22,062	100	107.4
Plot 3, ...	15,375	20,007	100	130.1
Plot 4, ...	22,167	20,595	100	92.9
Plot 5, ...	22,959	22,325	100	97.2

Attention is called to the fact that the differences this year, with one exception, are not very large, and that with the single exception alluded to it is the half-plot on which the soil conditions were least favorable which gives the smaller yield. The winter of 1903 and 1904 must be regarded as having been on the whole favorable to winter application. The ground, it is true, was deeply frozen before the coming of snow, but the winter was severely and continuously cold. There was a noticeable absence of winter rains and thaws, during which water washes in large quantities over the surface. In estimating the significance of the result, it must be kept in mind that it costs more to put manure first into a large heap and then in spring to take it from this heap and spread it, than it does to spread during the winter at the time the manure is hauled from the stable. The money difference in the cost of handling manure in the two ways, as shown by our experience, amounts to about $4.80 per acre. The difference in the value of the crops in favor of spring application is scarcely sufficient to cover this added cost, even on Plot 3, where such difference was greatest; and, although the unfavorable soil conditions above referred to doubtless lowered the product on that special plot where the manure was applied in the spring in three instances, plots 1, 4 and 5, it seems highly improbable that, even with equality of conditions, the gain from spring application on these plots would have given a degree of superiority sufficient to cover the added cost.

Previous reports have tended to show spring application to be advisable on this field, which has a considerable slope; and so I still believe it will in the long run prove to be. The exceptional character of the winter of 1903 and 1904 is a sufficient explanation of the difference in average results.

X. — Nitrate of Soda for Rowen.

This experiment is an effort to determine whether an application of nitrate of soda after the harvesting of the first crop will give an increase in rowen sufficient to cover the cost. The field where the experiment has been a number of times repeated is a mixed timothy and clover sod. It is divided into eight plots of like area, these plots being numbered 1 to 8 and each including about three-eighths of an acre. Nitrate of soda at the rate of 150 pounds per acre is applied to plots 2 and 4, while the application on Plot 6 is 200 pounds, and on Plot 8 250 pounds. To the remaining plots no nitrate is applied. The first crop of hay in this field was housed on July 14. The rate of yield was 6,314 pounds per acre. When this experiment has been tried in previous years, it has been found a matter of considerable difficulty to spread the relatively small amounts of nitrate of soda used evenly; and, as a means of obviating this difficulty, the nitrate used on each plot during the past season was mixed with basic slag meal. The amount of slag meal applied was 137½ pounds per plot, and the slag meal was applied to the plots receiving no nitrate as well as to the others, and on all in equal amounts. The mixture of slag and nitrate remained dry, and its even application was relatively easy. At the rates used, the nitrate and slag were mixed in proportions varying from about one nitrate to three slag to about one nitrate to two slag. Even with the higher proportions of nitrate to slag, the mixture remained dry and in convenient form for application. The rates of yields on the several plots are shown in the following table: —

Nitrate of Soda for Rowen. — Yields per Acre (Pounds).

[Basic slag meal at the rate of 137½ pounds per plot.]

Plots.	NITRATE USED (RATES PER ACRE).	Yield.
Plot 1, . . .	No nitrate, ...	716
Plot 2, . . .	Nitrate of soda, 150 pounds, ...	1,341
Plot 3, . . .	No nitrate, ...	990
Plot 4, . . .	Nitrate of soda, 150 pounds, ...	1,432
Plot 5, . . .	No nitrate, ...	853
Plot 6, . . .	Nitrate of soda, 200 pounds, ...	1,234
Plot 7, . . .	No nitrate, ...	1,021
Plot 8, . . .	Nitrate of soda, 250 pounds, ...	1,832

In the effort to determine whether the application of nitrate is profitable, the yield wherever it has been applied has been compared either with the yield of the nearest plot, or, in cases where it is possible, with the average yield of the two plots between which the plot under consideration lies to which no nitrate was applied. On this basis, the average increase due to application of 150 pounds of nitrate of soda was 499 pounds; the use of 200 pounds of nitrate of soda gave an apparent increase of 297 pounds; while the application of 250 pounds of nitrate of soda gave an apparent increase of 911 pounds. The weather during the period of growth of the rowen crop was too dry for the best results. At the rates of increase shown, the application would be hardly profitable.

XI. — VARIETY TEST, POTATOES.

During the past season we have carried out the second year's trial of forty-nine different varieties of potatoes, including practically all of those of recent origin advertised in prominent seed catalogues up to the spring of 1903, as well as two or three old standard sorts for comparison. The seed used this year was grown from the original stock of each of the varieties on our own grounds in the season of 1903. The seed of all varieties was carefully preserved during the winter under precisely similar conditions. In preparation for planting, the tubers were treated with formalin for prevention of scab, in the customary manner. After removal from the formalin solution, they were spread in a thin layer in an airy room April 30, where they were allowed to lie until the 17th of May, when the tubers were cut into pieces of about two or three eyes each, and planted. The soil used in this experiment is a medium loam. It produced a corn crop in the season of 1903, and mixed grass and clover seeds were sown in the standing corn. Neither grass nor clover had made much growth when the field was plowed on May 3 in preparation for the potatoes. The field received an application of barnyard manure at the rate of 4½ cords per acre, and fertilizers at the following rates: —

	Pounds.
Nitrate of soda,	175
Dried blood,	225
Acid phosphate,	625
Dry ground fish,	400
High-grade sulfate of potash,	350

Both manure and fertilizers were spread evenly after plowing, and harrowed in. The varieties grown and the rate of yield of each are shown in the following table: —

Variety Test Potatoes. — *Rates of Yield per Acre.*

VARIETY.	Merchantable (Bushels).	Small (Bushels).
Admiral Foote,	208	25
Beauty of Hebron (home grown),	204	35
Beauty of Hebron (Maine seed),	167	21
Clinton,	104	10
Crine's Lightning,	210	7
Daughter of Early Rose,	221	8
Daybreak,	167	29
Early May,	161	33
Early Nancy,	225	27
Early Norwood,	215	40
Early Rose,	256	29
Ensign Bagley,	192	38
Eureka Extra Early,	196	38
Extra Early Pioneer,	204	42
Extra Early White Rose,	294	6
Gem of Aroostook,	248	42
Governor Yates,	259	29
Great Divide,	273	31
Hamilton's Early,	225	8
I. X. L.,	256	38
John Bull,	217	8
Junior Pride,	171	38
Kaiser Krone,	154	50
King of Michigan,	197	60
King of Ohio,	125	29
Market Prize,	256	8
Maxima,	263	31
Million Dollar,	225	13
Mills' New Rose Beauty,	263	15
Milwaukee,	165	25
New Early Wisconsin,	183	33
New Surprise,	204	29
1904,	268	27
Nome,	204	13
Nott's Peachblow,	192	14

Variety Test Potatoes. — Rates of Yield per Acre — Concluded.

VARIETY.	Merchantable (Bushels).	Small (Bushels).
Pat's Choice,	217	11
Peck's Early,	223	10
Prince Henry,	206	17
Red River Triumph,	208	14
Red River White Ohio,	156	31
Sensation,	248	14
Simmon's Model,	319	25
Snowflake, Jr.,	252	8
Steuben,	268	38
Sweet Home,	140	48
Van Ornam's Earliest,	197	17
Vornehm,	185	33
White Ohio,	146	27

The growth of practically all varieties was normal and healthy. The vines were sprayed twice with Bordeaux mixture for prevention of blight and rot. The treatment was successful, and the yield of most varieties was good. One variety, Simmon's Model, gave a yield exceeding 300 bushels per acre. The smallest yield is that given by the Clinton, — 104 bushels of merchantable tubers per acre. Six varieties, mentioned in the order of their productiveness, gave yields of merchantable tubers at rates between 260 and 300 bushels per acre, viz.: Extra Early White Rose, Great Divide, Steuben, Maxima, 1904, Mills' New Rose Beauty. The Beauty of Hebron, which in previous variety tests has given yields almost as large as any under trial, takes a lower rank as the result of the test of last season.

XII. — POULTRY EXPERIMENTS.

The poultry experiments of the past season have followed along precisely similar lines to those followed last year. We are making an effort to throw light on the question as to the proper selection of feeds for laying fowls.

1. In the experiment comparing wheat with corn, animal meal being the source of the animal food used, the following

results were obtained: for the first period, February 3 to May 17, the wheat ration produced eggs at the average rate of .4333 per hen day; the corn ration at the rate of .3837 per hen day; in other words, 100 hens would have laid per day on the wheat ration 43⅓ eggs, and on the corn ration practically 38⅓ eggs per day. For the second period, May 17 to September 30, the wheat ration produced an average of .1911 eggs per hen day, the corn ration .2067 eggs per hen day; or, in other words, 100 hens would have laid on the wheat ration about 19⅒ eggs and on the corn ration 20⅔ eggs per day. The average food cost per egg produced was for the wheat ration .611 cents, for the corn ration .505 cents for the first period; while for the second period the cost per egg on the wheat ration was 1.657 cents, and on the corn ration 1.315 cents. The gross cost of the food on the wheat ration varied from about .24 to .30 cents per day for each fowl, while on the corn ration the cost varied from about .17½ to about .26 cents per day. The yield of eggs during the second period was very small. The small average product is to be attributed largely to the fact that the period was continued beyond the date when the hens began to molt. The 20 hens on the wheat ration laid only 82 eggs during the last two months of the experiment, while those on the corn ration laid only 158 eggs during the same time.

2. In the experiment comparing wheat with corn, with milk albumin as the source of animal food and with corn oil added as a source of fat, the egg product was as follows: for the first period, February 3 to May 17, the wheat ration produced eggs at the average rate of .463 eggs per hen day, the corn ration .4324 eggs per hen day; or, in other words, 100 hens would have laid on the wheat ration practically 46⅓ eggs per day, and on the corn ration 43¼ eggs per day. For the second period the wheat ration gave an average of .3109 eggs per hen day, the corn ration .3017 eggs per hen day; or, in other words, respectively for the wheat ration an average of 31 eggs per 100 hens daily, and for the corn an average of 30⅙ eggs. The food cost of the eggs in this experiment was as follows: for the wheat ration during the

first period .5471 cents per egg, for the second period 1.3406 cents; for the corn ration the figures were for the first period .3932 cents per egg, and for the second .918 cents. The cost of feeding the hens was: for the wheat ration during the first period at the rate of .227 cents per day, for the second period, .39 cents; for the corn ration the cost of food for the first period was .155 cents per hen daily, for the second period .263 cents. The egg yield in this as in the other experiment is very low for the second period. The causes are similar to those which have been pointed out under 1.

3. In the experiment comparing wheat with rice, and with milk albumin as the source of animal food, the results have been as follows: for the first period the egg production was: for the wheat ration .3813 per hen day, for the rice ration .4077; or, in other words, from 100 hens daily respectively about 38⅛ and 40¾ eggs per day. For the second period the averages were on the wheat ration .2244 eggs per hen day, and on the rice ration .3018 eggs per hen day; or from 100 hens daily respectively nearly 22½ and a little more than 30⅙ eggs per day. The food cost of the eggs has been as follows: for the wheat ration for the first period .6976 cents, for the second period 1.59 cents; for the rice ration for the first period 1.1863 cents, for the second period 2.379 cents. The cost of keeping the hens has been as follows: for the wheat ration during the first period .2414 cents per hen daily, for the second period .34 cents; for the rice ration for the first period .4442 cents per hen daily, and for the second period .7003 cents.

The ration including rice this year as last has given one of the most satisfactory egg products obtained. The high cost of this food at the present time seems to preclude its becoming a question of much practical importance whether rice is well or ill suited as a food for egg production. We have introduced it in our experiments as a means of testing the question as to whether fat is an important constituent in the food for laying hens, rice being lower in fat than any other grain we can obtain. The large egg product where rice is prominent among the foods used seems to indicate that fat is less important than has been judged as the result of some of our earlier experiments. Among the various grains, cleaned rice, as put upon our markets, contains least fiber, and rice is known to be the most digestible of all the grains. It is perhaps these pecularities of this grain which account for its apparent good effect on the egg product.

The nutritive ratios in the food combinations used in the different experiments of the past year have been as follows: —

For the rations where wheat is compared with corn with animal meal as the source of animal food: for the wheat ration, 1 : 4.46; for the corn ration, 1 : 6.42.

For the experiment in which wheat is compared with corn, milk albumin being the source of animal food: for the wheat ration, 1 : 4.43; for the corn ration, 1 : 6.18.

In the experiment in which wheat and rice have been compared: for the wheat ration, 1 : 4.35; for the rice ration, 1 : 6.2.

Our experiments throw relatively little light upon the question as to the proper nutritive ratio in feeding for eggs. The factors affecting the egg yield must be numerous, and others than the question of the nutritive ratio in the foods given to the fowls must often determine the results. The fact that we have the most satisfactory egg yield obtained during the past year on the rice ration, with a nutritive ratio of 1 : 6.20, does not at least seem to support the opinion that the nutritive ratio in feeding for eggs should be narrow.

REPORT OF THE HORTICULTURISTS.

F. A. WAUGH; GEO. O. GREENE, ASSISTANT.

The work of this division has followed the plans outlined in the reports of 1902 and 1903. The following subjects are ready for discussion, and reports are made herewith: —

I. Report on plums.
II. Experiments in pruning peach trees.
III. Growing chrysanthemums for a retail trade.

Report on Plums.

The horticultural department has a fairly large collection of plums. A number of these are represented by several trees each, enough to determine their commercial quality. The plum crop of 1904 was unusually good; it was abundant in quantity, and generally of good quality. This was true of all classes of plums, practically every variety on the grounds bearing a normal crop. This furnished an excellent opportunity for making observations on the different varieties. The notes follow below. It has been thought best to omit any extended description of these varieties for the present. This form of report is justified by the fact that nearly all the varieties mentioned are old and well-known sorts. The notes this year are valuable chiefly in showing the behavior of these well-known varieties in this particular locality. The problem of local adaption of varieties is nowadays considered to be one of the most important in horticulture, and in no class of fruits or vegetables are these local adaptations more complicated than with plums. The varieties below are classified as nearly as possible into the more commonly accepted pomological groups.

DOMESTICAS.

Agen (*Prune d'Agen*). — Tree unhealthy and a poor grower, moderately productive, an irregular cropper; fruit very good, but not so bright nor large as in some localities.

Bradshaw. — This is one of the best plums of its class, and, indeed, one of the best market and home-use plums of any class on our grounds. We have about twenty young trees in bearing which gave a good crop in 1904. The tree is a strong somewhat upright grower, does not come early into bearing, but bears well after reaching an age of eight to ten years. The fruit buds do not seem to be tender here, as they are in some localities. The fruit is large, smooth, bright and of excellent quality.

Bryanstone. — Tree an irregular and slow grower, late and irregular in bearing; not reliable. Fruit small to medium in size; of good quality.

Clyman. — Represented only by a single specimen, which bears sparsely and does not seem to be of any value.

Dame Aubert (*Yellow Egg, Magnum Bonum*). — Tree rather upright in growth, fairly strong and hardy, but does not bear heavily. Fruit large and fine, but very subject to rot.

Damsons. — Several varieties of Damsons are included in our collection, among which the French Damson seems to be the best; this bears fairly well, but by no means as abundantly as in some sections.

Diamond. — A fairly strong, healthy tree, coming late into bearing, and yielding uncertain crops here.

Englebert (*Prince Englebert*). — Tree upright, strong and hardy; does not come early into bearing, but yields good crops after reaching ten years of age. Fruit of medium size and fair quality.

Fellenburg (*Italian Prune*). — Tree round-topped, bushy, with spreading irregular branches; does not bear until eight or ten years of age, and then not very heavily. Fruit of good quality. This variety does not rank so highly as a market plum as in western New York or Michigan.

Field. — Tree seems to be not very strong and healthy, but bears fairly well. Fruit of excellent quality. This is a promising, medium early plum.

Giant Prune. — Our trees are young and poor, and have borne only a few samples. The fruit is large and attractive. This variety is worthy of further test.

Gueii. — Tree rather a bushy grower; fairly productive. Fruit small, sour; not of the best quality.

Hand. — Tree a large, strong grower; shapely; notably unproductive. Fruit large, fine, showy. This variety is certainly not worth planting, the objection being its unproductive character.

Lincoln. — Tree not very strong or sound, and fruit not of very good quality. Not to be recommended, on the basis of our experience.

McLaughlin. — Tree unhealthy and a poor grower; not bearing very heavily. Fruit not so smooth and highly colored as in some sections, but still of very fine quality. In spite of its imperfections of tree, this variety is worth growing on account of its high quality; it would not be profitable in a market orchard.

Moore's Arctic. — Tree vigorous, upright, strong, hardy; productive, and coming fairly early into bearing. Fruit small; rather poor quality.

Peter's Yellow Gage. — Tree not very vigorous or hardy; a slow grower. Fruit small, and not very good for this variety.

Pond. — Tree large, strong grower; fairly productive. Fruit large and excellent, but very much subject to rot, and unprofitable on that account.

Quackenbos. — A very good, medium-sized tree, fairly productive. Fruit medium size; clean and fair quality for one of the small blue plums. This is probably the best of the so-called blue plums, with possibly the exception of Englebert.

Reine Claude. — Tree an irregular grower; not very vigorous, and only moderately productive. Fruit medium size and quality for this variety; considerably subject to rot. This takes the place of the old-fashioned Green Gage, being a larger, better and later variety. It is a very fine plum for canning, but could not be profitably grown for the market in this locality.

Saratoga. — Our single tree of this variety is small, and not very productive; unpromising.

Smith's Orleans. — Tree moderate size, somewhat irregular in growth; moderately productive. Fruit not so large or fine as it should be in this variety.

Tragedy. —We have only one tree of this variety, just coming into bearing; promising.

Victoria. — Tree moderately large; irregular in growth; moderately productive. Fruit of medium size and excellent quality; somewhat subject to rot.

Washington. — In almost all respects like Hand, which see.

JAPANESE VARIETIES.

Abundance. — Tree upright, early bearing; very much subject to disease. This is probably one of the poorest trees to be found amongst the Japanese plums. Fruit of good size and good quality; somewhat subject to rot; very apt to be eaten by birds. We would entirely discard this variety as a commercial plum, on the basis of our experience, and could not recommend it highly for planting for home use. This experience we are aware is different from that of some other plum growers in New England.

Burbank. — Tree vigorous, spreading, hardy; comes early into bearing, and is very productive. Fruit medium to large, good quality; less subject to rot than most plums. This is the most profitable and productive market plum on our grounds.

Chabot. — Tree upright, vase form; hardy, prolific. Fruit medium size, round red; fair quality. This is an excellent market plum, medium to late in season.

Georgeson. — Tree spreading, rather large growing, vigorous and hardy; fairly prolific. Fruit large, yellow; good quality. This is an excellent canning plum, and worth growing in this section, although it does not sell well in the markets on account of its yellow color.

Hale. — Tree upright, very vigorous grower; somewhat subject to winter-killing; coming rather late into bearing, never bearing abundantly. Fruit medium size, round; excellent quality. According to our experience, this variety is not worth planting in this section.

October Purple. — Tree vigorous, upright, and very strong grower; somewhat subject to winter-killing; coming late into bearing, but giving moderate crops after reaching an age of seven or eight years. Fruit medium size, rather dull color; good quality. The variety does not seem to be of any special value in this section.

Paragon. — Somewhat like Chabot, but of no special value.

Red June. — Tree spreading, vase form; vigorous and relatively hardy. The fruit buds on this variety are less hardy than on Burbank, however, sometimes being killed while Burbank survives. Trees bear early and abundantly. The fruit is one of the first to come into the market, and, though of second quality, usually brings a fair price. This is proved to be a profitable plum with us.

Satsuma. — Tree upright, spreading, moderate grower; not very hardy, bearing rather sparsely. Fruit usually small with us; of indifferent quality. Although this variety succeeds in other localities in the Connecticut valley, it is of no value here.

HYBRID VARIETIES.

Apple. — Tree very vigorous, sprawling grower; hardy, coming fairly early into bearing. Fruit medium large, round; dark red with red flesh. On our grounds this variety promises to take the place of Satsuma, to which it seems to be superior in most respects.

Compass Cherry. — An interesting hybrid curiosity, but of no value.

Doris (doubtfully placed among hybrids). — Tree spreading, vigorous, hardy. Fruit small, watery; of no value.

Duke. — Tree medium strong, upright; fruited this year for the first time; of doubtful promise.

Gold (of Stark Brothers). — Tree small, spreading, irregular in growth; hardy, bearing early, but never abundantly on our grounds. Fruit round oblate, medium size, yellow, watery; poor quality, ripening very unevenly; much subject to rot. This variety is of no value with us, and our trees have been mostly grafted to other sorts.

Juicy. — Tree strong and hardy. Fruit small, yellow; of no value.

Wickson. — Tree upright, strong grower; rather tardy in coming into bearing, and never bearing heavy crops; fruit buds tender, apt to be frozen. Fruit of medium size, variable in quality; ripening very irregularly. This variety is not to be recommended here.

NATIVE VARIETIES.

There are on the grounds several native varieties, mostly Americanas, Hortulanas and Chickasaws. Some of these do fairly well, but none of them have conspicuous merit as grown in this section.

Marketing Plums.

The very excellent crop of 1904 gave us an opportunity to study the manner in which plums can be sent to market. For the most part the crop from the department of horticulture of the Massachusetts Agricultural College was marketed in three-pound baskets, such as are used for grapes;

when these were shipped by freight or express, they were packed in crates holding approximately one bushel. This style of package proved generally satisfactory; it furnishes about the quantity of fruit desired by most purchasers.

In making local sales, especially of plums for canning purposes, a larger package was usually more satisfactory. The so-called Jersey peach basket, holding sixteen quarts (one-half bushel), is the cheapest and most convenient.

In some cases, where fancy plums are designed for the fruit stand trade, they may be put up in quart baskets, such as are used for strawberries. We find these also satisfactory.

This whole matter may be summarized by saying that most markets are not fastidious with respect to the form of package used for plums. Any small, neat basket or box will answer, if the fruit is of good quality and well packed.

EXPERIMENTS IN PRUNING PEACH TREES.

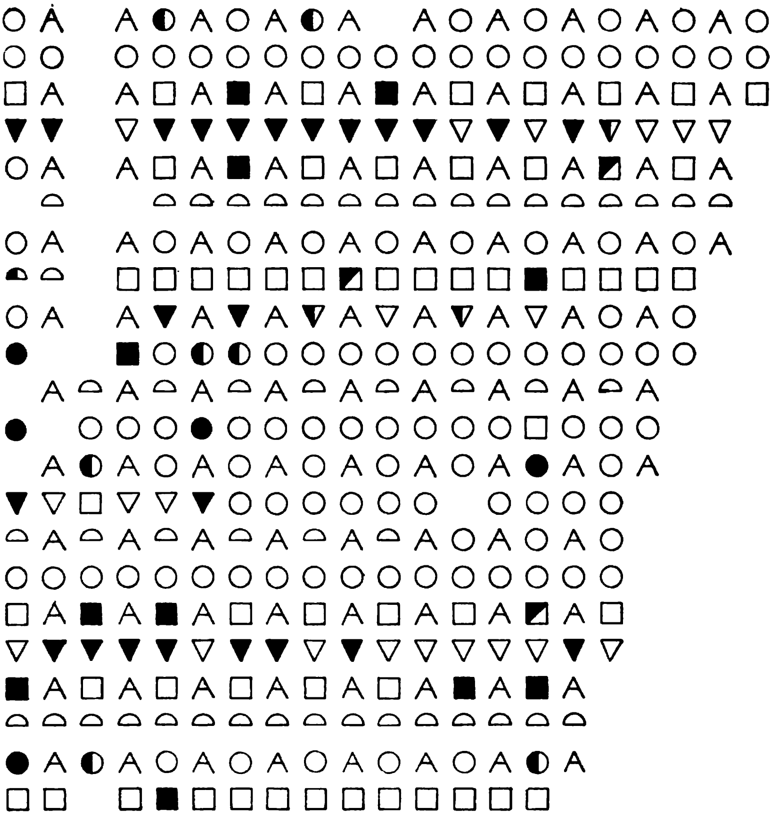
The department of horticulture has under way a series of experiments and special studies in pruning fruit trees. Reports on various phases of this work will be made from time to time as results are reached. At the present time we are able to make a report of progress in the experiments in pruning peach trees.

1. *The Results of No Pruning.*

One row of trees in the principal peach orchard has been left entirely without pruning from the first. This row runs crosswise of the variety rows, and therefore contains trees of all the varieties in the orchard, as follows: Oldmixon, Triumph, Mountain Rose, Elberta, Early Crawford, Late Crawford, Crosby. The trees are nine years old.

These trees, left unpruned for nine years, are plainly different from adjacent trees of the same varieties which have been pruned. Surprising as it may appear on first statement, they are more open-headed. They have generally assumed a vase form. The interior wood has died out, leaving the centres open, and at the same time leaving the lower part of the main branches bare. The fruiting wood is sparse, weak and high up in the trees. The trees are very much less thrifty and vigorous than the pruned trees of the same varieties. This lack of vigor is so marked that some of the weak trees succumbed more or less completely to the severe freezing of last winter.

The trees next the unpruned specimens have been headed back two or three times. They were all headed back moderately in the spring of 1902 and again in the spring of 1903, and some of them were headed back again in the spring of 1904. The trees so treated are thick-topped, with a good deal of weak, sappy growth on the inside, — a condition which is manifestly objectionable. On the other hand, the



MAP OF EXPERIMENTAL ORCHARD. — A shows apple trees 40 feet apart; the circles show peach trees unpruned; the half-circles show those slightly headed back; the squares indicate trees severely headed in; the triangles show trees cut back to stubs; the blackened figures represent trees which died in 1904.

annual growth has been much more vigorous, and the health of the trees has been much better. More and stronger fruit buds have been formed, but unfortunately the successive freezes of the last two winters have killed the buds, and made a comparison of fruit crops impossible. The main branches of the headed-back trees are shorter and stronger than those of the unpruned trees, and are obviously better able to support a large crop of fruit.

This experiment, which was begun by Prof. S. T. Maynard, and which has been continued through several years, has shown conclusively that the best form of peach tree cannot be secured and maintained without pruning.

2. *The Effect of Heading Back.*

Each spring, in the years 1902, 1903 and 1904, a number of trees in the college peach orchards were headed back. This shortening-in of the branches varied in amount: sometimes only one-third of the previous year's growth was cut away, sometimes one-half the year's growth was taken off, sometimes two-thirds was removed; in a few cases the trees were pruned clear back into two or three year old wood; in the majority of cases the heading-in amounted to about two-thirds of the previous year's growth. The cutting back in 1903 and in 1904 was more severe than it would have been had not the prospective fruit crop been wiped out by freezing.

In nearly all cases it was possible to compare trees thus headed in with other trees of the same varieties not so treated. The results were uniform and unequivocal. The trees headed back always made a more healthy and vigorous annual growth than the trees not so treated. In many cases the difference was remarkable, the growth of the pruned trees being from two to ten times as much as the unpruned trees. More and larger fruit buds formed on the pruned trees, and the shorter, stockier branches seemed better prepared to support a possible fruit crop. The foliage on the pruned trees was notably larger, more abundant and darker green. There was some tendency to the formation of weak shoots on the shaded interior branches.

The conclusion which we have reached from this experiment, continued through three years, is that the heading back of peach trees in early spring is good practice, and in all cases advisable. In this pruning from one-third to two-thirds of the wood of the previous year should be removed. In determining the exact amount to be cut away, the judgment of the fruit grower will be influenced largely by the number of living fruit buds in the one-year-old wood. If there is a crop in prospect, he will leave enough fruit buds to set the desired quantity of fruit. In years when, from one cause or another, there are no living fruit buds, he will take advantage of the circumstances to cut back with comparative severity. Only in extraordinary instances, however, will he remove all the previous year's wood, cutting back into two or three year old branches.

3. *Summer Pruning.*

It has been noted above that trees which were headed back in the early spring pruning showed a tendency toward the formation of many weak and useless shoots on the interior of the head. Experiments in summer pruning were begun with a view to the correction of this tendency, and also with a view to stopping the really inordinate extension of the main annual shoots of the current year. The two problems, however, were met in different ways.

The formation of weak sprouts on the interior of the tree is due chiefly to the exclusion of light. The external foliage of the tree top becomes so dense that the interior is shut off from the light and from much of the air. To improve the situation in this respect we have gone through the orchard once or twice between the middle of June and the middle of July, removing a considerable quantity of the new leafy shoots on the outside of the tree. A quantity of the outside shoots and foliage was thus removed sufficient to admit a reasonable amount of light to the inside of the tree top. The work was done with a pair of hand pruning shears, or, when the branches were soft, they were simply torn out with the bare hands. The latter method is preferable, because more expeditious.

In no case were the results of this treatment convincing. The formation of strong shoots with fruit buds on the interior branches was never visibly promoted. The outside branches which were allowed to remain seemed to profit somewhat by the removal of their crowding neighbors, and this was apparently the chief benefit derived from the work. On the whole, it does not seem to us that this practice is to be greatly recommended.

To correct the over-growth of outside branches, the plan was tried of cutting back the young growth. The tips were pinched or the shoots were pruned with hand pruning shears. Sometimes a foot or so of new growth was removed. The pruning was done at various seasons, usually some time in July.

In all cases this treatment was unsatisfactory. The stopping of the growing shoots is often — almost as a rule — followed by the pushing of side buds, and the shoots thus formed are nearly always too weak to set fruit buds, yet in putting out they ruin what might otherwise become strong, sound fruit buds.

4. *Pruning to renew Frozen Trees.*

As the spring of 1903 drew on, it was plain that more or less injury had been suffered by the trees in our peach orchards. In the spring of 1904 the damage was still more obvious and widespread. In both years some experiments were made to learn the best manner of handling a winter-injured tree.

The damage in the spring of 1903 proved to be small, and measures designed to have a corrective effect therefore showed meager results. All the trees came off about equally well, no matter how treated. Some were lightly headed in, some were severely headed in, while a few were cut back nearly to the main trunk, leaving only the stubs of the main branches. In every case not otherwise to be accounted for the tree recovered and made excellent growth.

In the spring of 1904 the trees were seriously weakened by freezing, and some were killed outright, so as to be beyond the reach of any remedial treatment. It should be said, however, that the damage proved to be less sweeping than was feared at the time the year's experiments were outlined. It was decided to lay off the orchard where this experiment was to be made into four blocks, to be given different kinds of treatment, as follows: (1) the first block was to be left entirely without pruning; (2) the second block was to be pruned in midsummer, after the trees had started; (3) the third block was to be cut back, from two-thirds to three-fourths of the previous year's growth being removed; (4) the fourth block was to be headed back near to the trunks, only the stubs of the main branches being left.

A certain percentage of these trees died during the year of 1904. The general result can be seen in the following table: —

Statistical Summary.

	Total Number pruned.	Living, Autumn of 1904.	Dead, Autumn of 1904.	Per Cent. Living.
Trees unpruned, ...	121	113	8	93
Moderately cut back, ...	48	47½	½	99
Severely cut back, ...	68	55	13	81
"Dehorned,"	46	24	22	52

It will be seen that the trees cut back to the trunks ("dehorned") suffered the worst; those severely cut back lost a larger percentage than those unpruned. A careful examination of the orchard itself makes it seem that the difference between blocks 2 and 3 in this respect is considerably exaggerated by the statistics. Some of the deaths in block 3 were apparently due to other causes, and should not be charged up against the pruning. Moreover, the growth made by the headed-in trees which lived was decidedly better than that made by the unpruned trees. The judgment of all those who saw the orchard and examined it carefully during the latter part of the summer of 1904 was that the trees moderately cut back showed the best growth and were in the best condition.

It at least seems clear that the trees seriously weakened by freezing should not be cut back close to the main trunks.

GROWING CHRYSANTHEMUMS FOR A RETAIL TRADE.

BY FRANCIS CANNING.

The work in the college greenhouses has to a certain extent been carried along on the lines and in many respects similar to that of a country florist's establishment, having a local trade. The many problems which present themselves under such conditions have been the subject of considerable experiment.

A florist's establishment in a country town is managed on a very different basis from that which obtains in growing cut flowers for the wholesale market, where two or three varieties of flowers are grown in quantity.

To meet the demands of a local trade requires the handling of a large variety of cut flowers and plants, not necessarily large in quantity, yet sufficient to meet the demand when any particular variety is in season.

One of the principal crops a florist grows under such conditions is the chrysanthemum, and it necessarily follows that he must be familiar with the earliest and latest flowering varieties, so as to prolong the season as far as possible. He must also ascertain which varieties are the best adapted for pot plants, also the colors which suit his trade.

The chrysanthemum having a short season, it follows that considerable forethought is necessary in the arrangement of space devoted to it; it frequently means the crowding of some other crops until that occupied by the chrysanthemum becomes available. To the uninitiated the transformation at the close of the chrysanthemum season, from beds filled with blooming plants to those occupied with other material, seems remarkable; yet the florist has long prearranged this matter in his mind. At this stage the saving of the necessary stock plants is done. In this connection a weeding out of undesirable varieties, or varieties that do not reach the standard in the grower's judgment, is accomplished. Various methods of saving the stock plants are practised; but we have found the use of boxes five or six inches in depth, with provision for drainage, to be a good method. It is better, however, not to mix several varieties in one box, for even though placed separately, the creeping stems will invade each other's territory, and result in mixing the varieties when the cuttings are taken. The boxes should be afforded a reasonably good place in a cool greenhouse, where the sun may reach them, so they do not have a soft, spindly growth, a condition exceedingly detrimental to future success.

Propagating commences in February, or much earlier when any special variety is to be considerably increased. After two batches of cuttings have been rooted, the boxes containing the stock plants may be thrown away, depending upon the newly propagated plants for future cuttings. From the earlier-rooted cuttings the varieties suitable for pot plants are selected, and are potted on as their needs demand. For the general stock for benching, or, in other words, for the cut flowers, the best time to propagate is from April 15 to May 1; thus suitable provision is made to have strong plants in two and one-half or three inch pots by the time the season arrives for planting. No specific date in this connection is observed, some florists commencing to plant in May and others late in July; but when the propagating has taken place at the previously mentioned date, the plants will be in good condition from the 15th to the end of June.

The question as to the advantages of solid beds or benches is of some interest. Our experience has been in favor of solid beds. We are, however, favored with a soil of a porous character, and gravelly subsoil, which for solid beds insures a good drainage, — a necessity for this crop. Wherever one may secure similar conditions, it would seem advisable to adopt this method, and thus avoid the expense of building benches and keeping them in repair.

The young plants are planted in rows eight inches apart each way, allowing two or three shoots to form, and thus secure the same number of blooms from each plant.

The soil used for benches and pot plants is a good, turfy loam, and is composted the previous fall or in the early spring of the same year. To three parts of soil is added one part of well-rotted manure, with bone meal to the amount of one quart to the barrowful of compost. To avoid fungous diseases, keeping the plants in good health by careful culture is the best preventative. For disposing of the ever-present aphis, or black fly, fumigation with tobacco has proved the surest and cheapest remedy. Throughout the year chrysanthemums should be subjected to a weekly fumigation, the prevention of insects being especially desirable in their successful management.

About forty varieties of chrysanthemums are grown in the college greenhouses, many of them represented by a few plants only, to ascertain their merits for such a trade as ours. This method of becoming acquainted with newer varieties should be adopted by all progressive florists. The fact remains, however, that many older varieties have not yet been superseded. Not infrequently the size of bloom has been the principal point in favor of the newer introductions, sacrificing in some instances their purity of color.

The following varieties have proved themselves well adapted for a local trade, being easily grown and naturally vigorous. In their order of flowering they are: white, — Polly Rose, Ivory, Alice Byron, Queen, Timothy Eaton, W. H. Chadwick, Merry Christmas; pink, — Glory of the Pacific, Pink Ivory, George Carpenter, Mrs. Perrin, Mrs. C. F. Berwind, Mrs. S. T. Murdock, Maud Dean; yellow, — Sinclair, Robert Halliday, Colonel Appleton, Major Bonaffon, W. H. Lincoln, W. H. Reiman; bronze, — Brutus, Sunrise, Petaluma; red, — Gettysburg, Malcome Lamond, Cullingfordii. The varieties that do well as pot plants are: Ivory, Alice Byron, Pink Ivory, Mrs. Perrin, Mrs. S. T. Murdock, Mrs. C. F. Berwind, Sinclair, Major Bonaffon, W. H. Lincoln, Brutus, Sunrise, Cullingfordii.

The singles and pompons should not be overlooked. They may be grown in pots with very little disbudding. They have a wide range of colors, and make salable pot plants; the white ones afford good material for designs, etc. Among the best may be mentioned Snowdrop, President, Julia Lagravere, Queen of England, Mizpah, Buttercup.

A great aid in the matter of testing the qualifications of varieties is the use of the "scale for judging" adopted by the Chrysanthemum Society of America. In scaling a variety a searching investigation is made, and many defects are apparent not ordinarily observed. In the work of the class in floriculture in the Massachusetts Agricultural College special emphasis has been placed upon judging chrysanthemums. Some practice will soon develop a rapid and correct estimate of the merits of varieties, and should prove valuable to the average florist.

The commercial scale is as follows : —

Color,	20	Substance,	15
Form,	15	Size,	10
Fullness,	10		
Stem,	15	Total,	100
Foliage,	15		

The score upon a number of varieties follows : —

Major Bonaffon.

Color,	18
Form,	12
Fullness,	10
Stem,	15
Foliage,	15
Substance,	12
Size,	10
Total,	92

The Queen.

Color,	15
Form,	10
Fullness,	6
Stem,	15
Foliage,	10
Substance,	8
Size,	10
Total,	74

Black Hawk.

Color,	20
Form,	7
Fullness,	10
Stem,	7
Foliage,	12
Substance,	8
Size,	8
Total,	72

Colonel Appleton.

Color,	20
Form,	12
Fullness,	8
Stem,	13
Foliage,	10
Substance,	12
Size,	10
Total,	85

These scores may vary from those awarded the same varieties by the Chrysanthemum Society of America. Our conditions may be accountable for the variation.

Some varieties present features especially desirable for a retail trade, — good keeping qualities, oddities in shape or color, etc. Those presenting desirable features, from two or three years' tests, follow : —

Baer, Mrs. G. F. — Known as Yellow Jerome Jones, and presents many of the fine characteristics of this fine variety.

Berwind, Mrs. C. F. — Dark pink, with silvery reverse; good keeper; a desirable kind.

Black Hawk. — Dark crimson; one of the handsomest of this color, and should be grown where there is any demand for this color.

Brutus. — Orange red; very dwarf in character; makes good pot plant and cut flowers; a desirable color, and satisfactory.

Byron, Miss Alice. — One of the best whites; makes a fine pot plant, and good for cut flowers.

Carpenter, George. — Medium early, dark pink flower; there is a demand for this variety when well grown.

Childs, G. H. — One of the best dark reds for cut flowers.

Dean, Maud. — One of the best pinks; large flower, good shape; fine for Thanksgiving trade.

Golden Trophy. — A desirable kind for pot plants.

Idavan. — Fine solid pink flower, shading to cream; a few are desirable.

Intensity. — Red; a good pot plant.

Jones, Mrs. Jerome. — One of the best whites.

Liberty. — A good late yellow; grown cool, will last till Christmas.

Merry Christmas. — A correspondingly late white variety.

Millbrook. — An odd salmon pink; a few pot plants may be serviceable.

Murdock, Mrs. S. T. — A desirable kind for cut flowers and plants; shell pink in color.

Mutual Friend. — A good white variety.

Petaluma. — An odd quilled-petalled variety; bronze or brown in color; good keeper.

Philadelphia. — Lemon yellow; globular flower; good for fancy trade.

Pitcher, Miss Georgiana. — A good old robust yellow variety, easily grown.

Reiman, W. H. — Yellow globular; late, good for Thanksgiving and later.

Rose, Polly. — An indispensable early variety.

Sunderbruch, H. L. — An early yellow; fine large flowers; good for pots.

Many other prominent varieties are being tested, a second year being desirable, to determine their value.

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OF THE

MASSACHUSETTS AGRICULTURAL COLLEGE.

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MASSACHUSETTS AGRICULTURAL COLLEGE,
AMHERST, Jan. 3, 1905.

To His Excellency JOHN L. BATES.

SIR: — I have the honor to transmit herewith, to Your Excellency and the Honorable Council, the forty-second annual report of the trustees of the Massachusetts Agricultural College.

I am, very respectfully, your obedient servant,

HENRY H. GOODELL,
President.

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CALENDAR FOR 1905-1906.

Jan. 4, 1905, Wednesday, fall semester resumed, at 8 A.M.
February 8, Wednesday, fall semester ends.
February 9, Thursday, spring semester begins, at 8 A.M.
March 29, Wednesday, to April 4, Tuesday, } spring recess.
April 4, Tuesday, spring semester resumed, at 8 A.M
June 17, Saturday, Grinnell prize examination of the senior class in agriculture.
June 18, Sunday, Baccalaureate sermon.
June 19, Monday, { Burnham prize speaking
Flint prize oratorical contest.
June 20, Tuesday, { Class-day exercises.
Meeting of the alumni.
Reception by the president and trustees.
June 21, Wednesday, commencement exercises.
June 22, 23, Thursday and Friday, examinations for admission, at 9 A.M., Botanic Museum, Amherst; at Jacob Sleeper Hall, Boston University, 12 Somerset Street, Boston; at Pittsfield; and at Horticultural Hall, Worcester.
September 19, 20, Tuesday and Wednesday, examinations for admission, at 9 A.M., Botanic Museum.
September 21, Thursday, fall semester begins, at 8 A.M.
December 20, Wednesday, to Jan. 3, 1906, Wednesday, } winter recess.
January 3, Wednesday, fall semester resumed, at 8 A.M.
February 7, Wednesday, fall semester ends.
February 8, Thursday, spring semester begins, at 8 A.M.
March 28, Wednesday, to April 3, Tuesday, } spring recess.
April 3, Tuesday, spring semester resumed, at 8 A.M.
June 20, Wednesday, commencement exercises.

ANNUAL REPORT OF THE TRUSTEES

OF THE

MASSACHUSETTS AGRICULTURAL COLLEGE.

His Excellency the Governor and the Honorable Council.

It has frequently been said that, if the people of this Commonwealth half realized the advantages offered their sons and daughters at the Massachusetts Agricultural College, it would be filled to overflowing. The past year has come nearer realizing this statement than any other, and yet an analysis of the annual report shows how far away we still are from reaching this happy condition, even though we have entered upon its very threshold. There are, roughly speaking, about 350 towns and cities in this State, and there ought to be at least an approximate representation from each one of these centres of population; instead of that, we find barely a 37 per cent. representation. We find our 273 students distributed among 130 towns, as follows: —

Abington,	1
Amesbury,	1
Amherst,	21
Andover,	1
Ashburnham,	1
Attleborough,	1
Barre,	2
Becket,	1
Belchertown,	4
Belmont,	1
Bernardston,	2
Boston,	4
Brimfield,	1
Brockton,	7
Brookfield,	2
Cambridge,	1
Campello,	1
Canton,	1
Cheshire,	1
Cochituate,	1
Cohasset,	1
Concord,	1
Curtisville,	1
Dana,	1
Dedham,	1
Deerfield,	1
Dorchester,	1
Easton,	2
East Brewster,	1
East Charlemont,	1
East Northfield,	1
East Pepperell,	2
Egremont,	1
Falmouth,	1
Fall River,	2
Florence,	2
Framingham,	1
Goshen,	1

Granby,	1
Greenwich Village,	1
Hadley,	3
Halifax,	1
Hinsdale,	1
Holliston,	1
Hopedale,	3
Hudson,	1
Hyde Park,	2
Jamaica Plain,	2
Lancaster,	2
Lee,	1
Lenox,	1
Leominster,	1
Lexington,	1
Lincoln,	1
Littleton,	1
Long Plain,	1
Lowell,	3
Ludlow,	1
Lynn,	2
Malden,	4
Marlborough,	1
Marshfield,	1
Maynard,	1
Medford,	1
Melrose Highlands,	1
Middleborough,	1
Milford,	1
Millbury,	6
Millis,	2
Monson,	1
Montague,	1
Natick,	6
Newburyport,	1
New Dorchester,	1
Newton,	2
Newtonville,	3
North Amherst,	2
North Brookfield,	1
Northampton,	1
Northfield,	1
North Grafton,	1
North Hadley,	1
Orange,	1
Osterville,	2
Peabody,	1
Pepperell,	2
Petersham,	1
Pittsfield,	2
Plainfield,	1
Reading,	1
Richmond,	2
Rockland,	2
Roslindale,	1
Roxbury,	3
Rutland,	1
Salem,	2
Saugus,	1
Scituate,	1
Sherborn,	1
Somerville,	6
South Amherst,	2
South Boston,	1
Southborough,	1
Southbridge,	1
South Framingham,	1
South Hadley,	1
South Natick,	1
Southwick,	2
Spencer,	1
Springfield,	4
Sterling,	1
Stockbridge,	1
Stoughton,	2
Sunderland,	2
Swampscott,	3
Taunton,	1
Templeton,	1
Tewksbury,	1
Townsend,	2
Waltham,	4
Westborough,	3
West Dracut,	1
Westfield,	2
Westford,	2
West Millbury,	1
West Roxbury,	1
Wilkinsonville,	1
Winchester,	1
Winthrop,	2
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China, Barbados and Japan furnish 1 each; the remaining 36 are distributed in the following States: Connecticut, Illinois, Kansas, New Hampshire, New York, New Jersey, Vermont, Tennessee, Iowa, Maine, California, Georgia.

It seems difficult to secure a foothold in the west and north-west portions of the State, and perhaps it is fortunate that it was so this year, for the attendance has been so large that it has been found impossible to give the students the education offered them in our report. In the senior and graduate classes we have been compelled to refuse 3 students for lack of room in the entomological department, and next year the pressure will be still greater. In the horticultural department we have had to simply say to the junior class, "We cannot give you the education promised, — our accommodations are too small;" and next year we shall find ourselves confronted with a still worse condition of affairs. Our freshman class has suffered the most, for we have been compelled to divide it into three sections, and to debar the last (25 men) from work in botany. How it can ever be made up I do not see, without increased facilities in room and equipment. Your committees, last year, reported a bill advocating increased accommodations, but it did not seem wise to press it. We return this year, asking that you will supply us with the means to adequately furnish the education required by our charter and the laws of this Commonwealth. It is a matter of absolute necessity, and does not admit of any delay. Before this, some kind of provision could be made; but with entering classes of 70 and 80 it is now quite impossible, and means one of two things, — either retrogression and frankly disowning a portion of the course, or else attempting to carry it on in a half-hearted way, — a source of shame to ourselves and a constant element of discontent to the student.

The botanical, horticultural and entomological departments demand immediate assistance. The last mentioned can be easiest and most quickly reached by increasing the length of the building, and repairing the greenhouse used in connection with breeding and destroying insects, at a cost of say $3,000. The kind of work in which the students are engaged here is mostly microscopic, and necessitates individually more room and more light than in the ordinary recitation room. These two features, for a limited number, can be secured in the manner above indicated.

For the horticultural department an entirely new building, exclusive of its greenhouse, can be erected and equipped at a cost not to exceed $40,000, and $1,000 annual maintenance fund. This will provide for all classes in market gardening, horticulture, floriculture, greenhouse management and landscape gardening, and relieve the congested condition of the botanical department. A fine building, 50 by 70 feet, one story and a half on its front and three on its rear, containing laboratory, photographing rooms, landscape gardening and recitation rooms, can be put up for the sum mentioned. This building is a necessity. The only room the department now can call its own is the botanic museum, where all specimens have been made useless by being pushed back to the wall, to allow room for tables, seats and other equipment.

We have said that $40,000 would put up, equip and properly furnish a brick building, as nearly fireproof as may be, for carrying on the work of this department. The different items tabulate as follows: —

Building,	$29,000
Heating,	3,000
Grading and roads,	1,500
Furnishing and equipment,	4,500
Electric lights,	500
Architects' fee,	1,450
Total,	$39,950

But in addition to these items is the one most important of all, — a modern greenhouse, for the purpose of teaching the growing of crops from the commercial standpoint. If this cannot be taught, then we shall have deplorably failed in all our instruction. The whole object of the investigations of the great father of philosophy was *utility*, and from his day on to this the world has gone on advancing, and its condition has been improving. A greenhouse not costing over $14,600, and including salesroom and heating, is needed for the practical demonstration of growing for the market flowers and market-gardening stuffs.

The botanical department has for thirty-seven years been handicapped by everything belonging to any other department for which room could not be found elsewhere. It has gladly given shelter to zoölogy, entomology, physiology, geology, and, in fact, to most of the natural sciences it has shown itself a tender mother. Last to ask anything for itself, it has nearly the same old equipment of two-score years ago. Everything has been outgrown, and the demands upon it far exceed its available resources. With rooms, at a maximum, furnishing room and accommodation and apparatus for 30, it now has classes of 75 to 80, with every prospect of increase in the coming years. To provide not only for the necessities of the present, but to look ahead and see that the possibilities of the future are supplied, is the problem that confronts us. It has seemed wiser to group together the buildings of the station and college, in order that the teacher may take advantage of the investigations of the experimenter. This building, then, although absolut ly distinct, partakes rather of an addition to the botanical division of the experiment department than to a separate building. It provides for teaching the botany of all the undergraduate as well as the graduate classes. It provides laboratory room, double the capacity of that at present employed. It furnishes lecture rooms for audiences of at least 150, and, most important, presents an up-to-date building, equipped with the most modern appliances and instruments for prosecuting the study of botany. For the erection and equipment of this building there will be required an outlay of $35,900, and an annual maintenance fund of $1,000.

Summing up briefly our needs, we require for the —

Entomological division,	$3,200
Horticultural: —	
Building,	29,000
Heating,	3,000
Grading and roads,	1,500
Furnishing and equipment,	4,500
Architects' fee,	1,450
Electric lights,	500
Greenhouse,	14,600
Annual maintenance fund,	1,000

Botanical: —	
Building and equipment,	$35,900
Annual maintenance fund,	1,000
For duplicate generator of heating and lighting plant, not to exceed	5,000
For painting barn,	1,000
For improvement of live stock,	5,000
For extending heating and lighting plant to vegetable pathology and horticultural buildings,	8,500

In accordance with the Acts and Resolves of the General Court, 1904, creating a forester, it was made one of his duties to deliver a course of lectures at the Massachusetts Agricultural College. It is briefly outlined by State Forester Akerman as follows: —

> This is a course of twelve lectures on the art and science of forestry, to be given by the State Forester, in accordance with the statute which established his office. The first five of these lectures will deal with forestry in general, its scope and meaning to civilization; the remaining lectures will be on problems presented by the forest conditions of this Commonwealth, and especially those which arise in connection with farm wood lots. The college wood lot will be used to illustrate some of the subjects dealt with in the lectures. The course is to be given in the early months of the year.

The college exhibit made at the St. Louis fair was participated in by the departments of agriculture, botany, entomology, horticulture, chemistry, veterinary and English, and was intended to show the work of college and station. It seems to have been a success, for the *grand prix* was awarded us. The different articles of exhibit were as follows: —

First. — Each of the departments mentioned contributed a set of photographs, illustrating buildings, lecture rooms and laboratories, and the equipment used in its work. The literary work of the alumni of the college was shown by as complete an exhibit as could be brought together of the books which have been published by alumni. This exhibit included about thirty volumes, treating a considerable variety of subjects; a large proportion pertained to agriculture, or the sciences closely connected therewith.

Second. — Aside from the general material which has already been mentioned, a number of the departments were represented by special exhibits. The more important features of the exhibit made by each will be made clear by the following statement: —

Agricultural Department. — This department exhibited a large number of specimen sheaves and preserved plants and seeds of the more important crops of the State. Especially prominent were those which were introduced into the United States by the head of the department.

The methods and results of an experiment to determine the relative availability of fertilizers were shown in facsimile by means of artificial plants made to scale, set into the pots actually used in the experiments.

The results of an experiment in feeding hens for eggs were shown by two parallel series of glass jars and cases, in which the contrasted methods of feeding were made clear by showing the different foods in layers. The basis adopted was the average requirements and product of one hen for one month. Besides the actual foods, the exhibit showed the total of nutrients contained in the foods used under the two systems, the number of eggs laid by a single hen in one month under each system of feeding, and the total of the nutrients given in the foods recovered in the eggs.

The results of an experiment with fertilizers in the field were shown to exact scale in high and narrow glass jars, eight in number, each containing the product in shelled corn of one thousandth part of an acre.

Horticultural Department. — Some idea of the nature of the work in this department along educational lines was afforded by means of a collection of drawings, some twenty in number, prepared by students as a regular feature of their work. A line of investigation in which the department has been especially prominent was represented by means of a collection of specimens showing variation in the nature of graft unions. The department also exhibited a collection of wax models, designed to show the originals from which each of the various cultivated fruits has been developed, and the different highly improved forms which have been produced from these originals.

Department of Botany and Vegetable Pathology.— This department showed a large collection of apparatus employed in determining the percentage of germination of seeds, apparatus which has been used in studying the effect of electricity on the germination of seeds, and models of a number of different types of apparatus employed in sterilizing the soil in greenhouses for prevention of disease. The department showed also a large number of specimens illustrating the effects of fungous diseases. A part of these were mounted in gelatine held between plates of glass, — a method which has been perfected in the department, and which preserves the color and natural appearance in a very perfect manner; while a portion of the specimens had been dried, pressed and mounted on cotton. The department also showed a collection including many of the important mushrooms, represented by means of beautifully made paper models; there were three dozen specimens in this collection.

Department of Entomology.— This department showed eight glass-topped trays of insects, illustrating the following educational topics: —

I. Life history of the gypsy moth: its parasites and insect enemies.

II. Life history of the brown-tail moth: its parasites and insect enemies.

III. Examples of cases of the mimicry of one insect by another, occurring in Massachusetts.

IV. Examples of cases of the imitation of various objects, such as twigs, bark, etc., by insects.

V. The modern ideas as to the genealogy and relation to each other of the different groups of insects, with specimens of each group.

VI. Specimens showing differences of form, color or markings in the sexes (antigeny).

VII. A complete life history of the apple tree tent caterpillar, showing the meaning of a life history.

VIII. Specimens of our chief insect pests, showing which are native to this country and which are introduced.

Chemical Department. — The exhibit of this department filled a large case, and was designed to illustrate educational methods of research in the department. The exhibit included a large number of specimens of chemical compounds prepared in the laboratory.

Veterinary Department. — The exhibit of this department included a large number of models and especially prepared specimens used in illustrating the anatomy of each of the various domestic animals. Many of the prepared specimens were the work of students or alumni of the college.

At the meeting of the trustees in Amherst, June 14, 1904, a committee was appointed to draft resolutions on the death of Charles L. Flint. The following tribute to Mr. Flint was presented to the trustees at their meeting on Jan. 3, 1905: —

TRIBUTE TO CHARLES LOUIS FLINT.

In the death of Charles Louis Flint this Board has lost one of its most faithful members. Although quiet and unassuming in manner, he was forceful and resourceful in character. Always considerate, always honorable in his dealings with men, he won their respect and confidence. His father, a graduate of Harvard, and for many years secretary of this Board, gave his two sons their choice between the Agricultural College at Amherst and Harvard College at Cambridge, hoping they would select the former, which they both did. Mr. Flint, our late associate, never regretted his choice, was always proud of his alma mater, and defended her on every and all occasions. He showed his good will in deeds as well as in kind words, for, when the time came to help the college, he established, and for several years maintained, the "Flint Rhetorical Prizes," which, along with the Burnham prizes, have accomplished so much for our English department. The college has indeed lost a loyal supporter and helpful friend, and this Board a quiet, modest, lovable, yet dignified associate.

We desire to record here our grateful remembrance of his wise generosity and thoughtful service to his alma mater, and to extend to his family our deep sympathy in the loss of a true husband and a devoted father.

His classmate and college chum, Dr. Hills of Vermont, paraphrasing another, wrote concerning him: "I believe that, while Mounts Holyoke, Tom and Toby have never occupied chairs in the faculty of this college, they have been as potent factors in the shaping of the character of its students as have many even of its best instructors; and I think I see their quiet, beauty, dignity and strength reflected in the character and life of our friend, Charles Louis Flint."

William Wheeler,
W. H. Bowker,
E. D. Howe,
Committee.

Respectfully submitted, by order of the trustees,

HENRY H. GOODELL,
President.

Amherst, Jan. 3, 1905.

THE CORPORATION.

	TERM EXPIRES
WILLIAM H. BOWKER of Boston,	1906
GEORGE H. ELLIS of Boston,	1906
J. HOWE DEMOND of Northampton,	1907
ELMER D. HOWE of Marlborough,	1907
NATHANIEL I. BOWDITCH of Framingham,	1908
WILLIAM WHEELER of Concord,	1908
ARTHUR G. POLLARD of Lowell,	1909
CHARLES A. GLEASON of New Braintree,	1909
JAMES DRAPER of Worcester,	1910
SAMUEL C. DAMON of Lancaster,	1910
MERRITT I. WHEELER of Great Barrington,	1911
CHARLES H. PRESTON of Danvers,	1911
WILLIAM R. SESSIONS of Springfield,	1912
M. FAYETTE DICKINSON of Boston,	1912

Members ex Officio.

His Excellency Governor JOHN L. BATES,
President of the Corporation.

HENRY H. GOODELL, *President of the College.*
GEORGE H. MARTIN, *Secretary of the Board of Education.*
J. LEWIS ELLSWORTH, *Secretary of the Board of Agriculture.*

WILLIAM R. SESSIONS of Springfield.
Vice-President of the Corporation.

J. LEWIS ELLSWORTH of Worcester, *Secretary.*
GEORGE F. MILLS of Amherst, *Treasurer.*
CHARLES A. GLEASON of New Braintree, *Auditor.*

Committee on Finance and Buildings.*

WILLIAM R. SESSIONS, J. HOWE DEMOND,
ARTHUR G. POLLARD, CHARLES H. PRESTON,
CHARLES A. GLEASON, *Chairman.*

Committee on Course of Study and Faculty.*

WILLIAM H. BOWKER, ELMER D. HOWE,
M. FAYETTE DICKINSON, GEORGE H. ELLIS,
WILLIAM WHEELER, *Chairman.*

Committee on Farm and Horticulture.*

Farm Division.

GEORGE H. ELLIS, N. I. BOWDITCH,
MERRITT I. WHEELER, WILLIAM R. SESSIONS, *Ch'man.*

Horticultural Division.

JAMES DRAPER, ELMER D. HOWE,
J. L. ELLSWORTH, *Chairman.*

Committee on Experiment Department.*

J. LEWIS ELLSWORTH, CHARLES H. PRESTON,
WILLIAM H. BOWKER, SAMUEL C. DAMON,
JAMES DRAPER, *Chairman.*

Committee on New Buildings and Arrangement of Grounds.*

WILLIAM WHEELER, SAMUEL C. DAMON,
M. FAYETTE DICKINSON, N. I. BOWDITCH,
JAMES DRAPER, *Chairman.*

Board of Overseers.

STATE BOARD OF AGRICULTURE.

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* The president of the college is ex officio a member of each of these committees.

Examining Committee of Overseers.

JOHN BURSLEY (*Chairman*),	of West Barnstable.
C. K. BREWSTER,	of Worthington.
W. C. JEWETT,	of Worcester.
ARTHUR A. SMITH,	of Colrain.
CHARLES H. SHAYLOR,	of Lee.

The Faculty.

HENRY H. GOODELL, LL.D., *President*,
Professor of Modern Languages.

CHARLES A. GOESSMANN, Ph.D., LL.D.,
Professor of Chemistry.

CHARLES WELLINGTON, Ph.D.,
Associate Professor of Chemistry.

CHARLES H. FERNALD, Ph.D.,
Professor of Zoölogy.

Rev. CHARLES S. WALKER, Ph.D.,
Professor of Mental and Political Science.

WILLIAM P. BROOKS, Ph.D.,
Professor of Agriculture.

GEORGE F. MILLS, M.A.,
Professor of English and Latin.

JAMES B. PAIGE, D.V.S.,
Professor of Veterinary Science.

GEORGE E. STONE, Ph.D.,
Professor of Botany.

JOHN E. OSTRANDER, M.A., C.E.,
Professor of Mathematics and Civil Engineering.

HENRY T. FERNALD, Ph.D.,
Professor of Entomology.

JOHN ANDERSON, Major, U. S. A.,
Professor of Military Science and Tactics.

FRANK A. WAUGH, M.S.,
Professor of Horticulture and Landscape Gardening.

RICHARD S. LULL, Ph.D.,
Associate Professor of Zoölogy.

PHILIP B. HASBROUCK, B.S.,
Associate Professor of Mathematics.
Adjunct Professor of Physics.

HERMAN BABSON, M.A.,
Assistant Professor of English and Instructor in German.

FRED S. COOLEY, B.Sc.,
Assistant Professor of Agriculture.
(Animal Husbandry and Dairying.)

SAMUEL F. HOWARD, B.Sc.,
Assistant Professor of Chemistry.

LOUIS R. HERRICK, B.Sc.,
Instructor in French and Spanish.

HENRY J. FRANKLIN, B.Sc.,
Instructor in Botany.

GEORGE O. GREENE, M.S.,
Instructor in Horticulture.

FRANCIS CANNING,
Instructor in Floriculture.

ROBERT W. LYMAN, LL.B.,
Lecturer on Farm Law.

E. FRANCES HALL,
Librarian.

RICHARD S. LULL, PH.D.,
Registrar.

ELWIN H. FORRISTALL, M.Sc.,
Farm Superintendent.

Graduates of 1904.[*]

Ahearn, Michael Francis,	Framingham.
Back, Ernest Adna (Boston Univ.),	Florence.
Blake, Maurice Adin,	Millis.
Couden, Fayette Dickinson,	Amherst.
Elwood, Clifford Franklin,	Green's Farms, Conn.
Fulton, Erwin Stanley,	Lynn.
Gilbert, Arthur Witter (Boston Univ.),	Brookfield.
Gregg, John William (Boston Univ.),	South Natick.
Griffin, Clarence Herbert,	Winthrop.
Haskell, Sidney Burritt,	Southbridge.
Henshaw, Fred Forbes,	Templeton.
Hubert, Zachary Taylor (Boston Univ.),	Pride, Ga.
Newton, Howard Douglas (Boston Univ.),	Curtisville.
O'Hearn, George Edmund,	Pittsfield.
Parker, Sumner Rufus,	Brimfield.
Peck, Arthur Lee (Boston Univ.),	Hartford, Conn.
Quigley, Raymond Augustine,	Brockton.
Raymoth, Reuben Raymond,	Goshen.
Staples, Parkman Fisher (Boston Univ.),	Westborough.
White, Howard Morgan,	Springfield.

Two-Years Course.

Hunt, Justine,	Newton.	
Total,		21

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[*] The annual report, being made in January, necessarily includes parts of two academic years, and the catalogue bears the names of such students as have been connected with the college during any portion of the year 1904.

Senior Class.

Adams, Richard Laban,	Jamaica Plain.
Allen, George Howard,	Somerville.
Barnes, Hugh Lester,	Stockbridge.
Bartlett, Francis Alonzo,	Belchertown.
Crosby, Harvey Davis,	Rutland.
Cushman, Esther Cowles,	Amherst.
Gardner, John Joseph,	Milford.
Gay, Ralph Preston,	Stoughton.
Hatch, Walter Bowerman,	Falmouth.
Hill, Louis William Barlow,	Greenfield Hill, Conn.
Holcomb, Charles Sheldon,	Tariffville, Conn.
Hunt, Thomas Francis,	Amherst.
Hutchings, Frank Farley,	South Amherst.
Ingham, Norman Day,	Granby.
Kelton, James Richard,	Orange.
Ladd, Edward Thorndike,	Winchester.
Lewis, Clarence Waterman,	Melrose Highlands.
Lyman, John Franklin,	Amherst.
Munson, Willard Anson,	Aurora, Ill.
Newhall, Jr., Edwin White,	San Francisco, Cal.
Patch, George Willard,	Lexington.
Richardson, Justus Cutter,	West Dracut.
Sanborn, Monica Lillian,	Salem.
Sears, William Marshall,	Brockton.
Swain, Allen Newman,	New Dorchester.
Taylor, Albert Davis,	Westford.
Tompson, Harold Foss,	Jamaica Plain.
Tupper, Bertram,	Barre.
Walker, Lewell Seth,	Natick.
Whitaker, Chester Leland,	Somerville.
Williams, Percy Frederic,	Natick.
Willis, Grenville Norcott,	Becket.
Yeaw, Frederick Loring,	Winthrop.
Total,	33

Junior Class.

Carey, Daniel Henry,	Rockland.
Carpenter, Charles Walter,	Monson.
Chapman, George Henry,	New Britain, Conn.
Colton, William Wallace,	Pittsfield.

Craighead, William Hunlie,	Boston.
Ferren, Frank Augustus,	Peabody.
Filer, Harry Burton,	Belchertown.
French, George Talbot,	Tewksbury.
Gaskill, Edwin Francis,	Hopedale.
Hall, Jr., Arthur William,	North Amherst.
Hastings, Jr., Addison Tyler,	Natick.
Hayward, Afton Smith,	South Amherst.
Hood, Clarence Ellsworth,	Millis.
Jones, Louis Franklin,	Somerville.
Kennedy, Frank Henry,	South Boston.
Martin, James Edward,	Brockton.
Moseley, Louis Hale,	Glastonbury, Conn.
Mudge, Everett Pike,	Swampscott.
Paige, George R.,	Amherst.
Peakes, Ralph Ware,	Newtonville.
Pray, Fry Civille,	Natick.
Racicot, Jr., Arthur Alphonse,	Lowell.
Rogers, Stanley Sawyer,	Boston.
Russell, Henry Merwin,	Bridgeport, Conn.
Scott, Edwin Hobart,	Cambridge.
Sleeper, George Warren,	Swampscott.
Strain, Benjamin,	Mt. Carmel, Conn.
Suhlke, Herman Augustus,	Leominster.
Taft, William Otis,	East Pepperell.
Tannatt, Jr., Willard Colburn,	Dorchester.
Tirrell, Charles Almon,	Plainfield.
Wellington, Richard,	Waltham.
Wholley, Michael Francis,	Cohasset.
Wood, Alexander Henry Moore,	Easton.
Total,	34

Sophomore Class.

Alley, Harold Edward,	Newburyport.
Arimoto, Shintaro,	Oharamura, Aidagun, Mimasaka, Japan.
Armstrong, Arthur Huguenin,	Hyde Park.
Barlow, Waldo Darius,	Amherst.
Bartlett, Earle Goodman,	Chicago, Ill.
Brydon, Robert Parker,	Lancaster.
Caruthers, John Thomas,	Columbia, Tenn.

Chace, Wayland Fairbanks,	Middleborough.
Chadwick, Clifton Harland,	Cochituate.
Chapman, Joseph Otis,	Brewster.
Chapman, William Spaulding,	Attleborough.
Clark, Jr., Milford Henry,	Sunderland.
Clementson, Lewis Towland,	Millbury.
Cowles, Edward Russell,	Deerfield.
Curtis, Jesse Gerry,	South Framingham.
Curtis, Walter Leon,	Scituate.
Cutter, Frederick Augustus,	Pelham, N. H.
Dearth, George Augustus,	South Framingham.
Denham, Edwin Tirrell,	Rockland.
Dickinson, Walter Ebenezer,	North Amherst.
Dudley, Fred Samuel,	Montague.
Eastman, Jasper Fay,	Townsend.
Engstrom, Nils,	Lancaster.
Farrar, Allan Dana,	Amherst.
Gould, Harry Wheeler,	Millbury.
Green, Herbert Henry,	Spencer.
Hall, Jr., Walton,	Marshfield.
Hartford, Archie Augustus,	Westford.
Higgins, Arthur William,	Westfield.
Jones, Arthur Merrick,	Ludlow.
King, Clinton,	Easton.
Larned, Joseph Adelbert,	Amherst.
Leighton, Carl,	Lowell.
Leominster, William,	Long Plain.
Lincoln, Ernest Avery,	Fall River.
Livers, Susie Dearing,	Boston.
Parker, Charles Morton,	Newtonville.
Perkins, Edward Cook,*	Springfield.
Peters, Frederick Charles,	Lenox.
Philbrick, Edwin Daniels,	West Somerville.
Pierce, Henry Tyler,	West Millbury.
Pray, Rutledge Peyton,	Natick.
Raitt, John Archibald,	New York, N. Y.
Rice, Charles Arthur Allenham,	Springfield.
Russell, Herbert Osborne,	North Hadley.
Searle, George Whitney,	Westfield.
Shaw, Edward Houghton,	Belmont.
Shaw, Frank Elmer,	Brockton.

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* Died June 20, 1904.

Stoddard, Calder Sankey,	Canton.	
Summers, John Nicholas,	Brockton.	
Thompson, Clifford Briggs,	Halifax.	
Walker, James Hervey,	Greenwich Village.	
Watkins, Fred Alexander,	Hinsdale.	
Watts, Ralph Jerome,	Littleton.	
Whitney, John Frank,	Dana.	
Wood, Herbert Poland,	Hopedale.	
Total,		56

Freshman Class.

Allen, Charles Francis,	Worcester.
Allen, Herbert Carpenter,	East Northfield.
Anderson, Albert John,	North Brookfield.
Anderson, Kenneth French,	Roslindale.
Austin, Frank Lee,	Potsdam, N. Y.
Bailey, Ernest Winfield,	Worcester.
Bangs, Bradley Wheelock,	Amherst.
Barry, Thomas Addis,	Amherst.
Bartlett, Louis Warren,	Amherst.
Bates, Carleton,	Salem.
Bennett, Ernest Victor,	Malden.
Blake, Rodman Ruggles,	East Pepperell.
Blakely, Franklin Chambers,	Medford.
Browne, Marcus Metcalf,	Malden.
Caldwell, John Snow,	Lynn.
Carter, Henry Rufus,	Millbury.
Chapman, Lloyd Warren,	Pepperell.
Chase, Henry Clinton,	Swampscott.
Clark, Orton Loring,	Malden.
Cobb, George Robert,	Amherst.
Coleman, William John,	Natick.
Cox, Leon Clark,	Boston.
Cummings, Winthrop Atherton,	Belchertown.
Cutting, Roy Edward,	Amherst.
Damon, Henry Frank,	Belchertown.
Daniel, John,	Osterville.
Davenport, Stearnes Lothrop,	North Grafton.
Davis, Paul Augustin,	Lowell.
Dolan, Clifford,	Hudson.
Draper, James Edwin,	Worcester.

Eastman, Perley Monroe,	Townsend.
Edmands, Ernest Carl,	Saugus.
Edwards, Frank Laurence,	Somerville.
Farley, Arthur James,	Waltham.
Farrar, Parke Warren,	Springfield.
Flint, Clifton Leroy,	Amesbury.
Fullam, Charles Francis,	North Brookfield.
Gillett, Chester Socrates,	Southwick.
Gillett, Kenneth Edward,	Southwick.
Gold, Frank Lyman,	Amherst.
Goodwin, Chester Linwood,	Brockton.
Gowdey, Carlton Cragg,	St.Michael,Barbados.
Hamburger, Amos Francis,	Hyde Park.
Hayes, Herbert Kendall,	North Granby, Conn.
Hayward, Warren Willis,	Millbury.
Howe, William Llewellyn,	Marlborough.
Hyslop, James Augustus,	Rutherford, N. J.
Ingalls, Dorsey Fisher,	Cheshire.
Jackson, Raymond Hobart,	Amherst.
Jennison, Harry Milliken,	Millbury.
Johnson, Frederick Andrew,	Westford.
Jones, Thomas Henry,	Easton.
Lacouture, George Louis,	Millbury.
Larsen, David,	Bridgeport, Conn.
Liang, Lai-Kwei,	Tientsin, China.
Miller, Danforth Parker,	Worcester.
Negus, Philip Henry,	Fall River.
O'Grady, James Raphael,	Holliston.
Pagliery, Joseph Cecilio,	New York, N. Y.
Parker, John Robert,	Poquonock, Conn.
Potter, John Sherman,	Concord.
Reed, Horace Bigelow,	Worcester.
Regan, William Swift,	Northampton.
Sawyer, William Francis,	Sterling.
Shattuck, Leroy Altus,	Pepperell.
Smith, George Franklin,	Barre.
Thurston, Frank Eugene,	Worcester.
Turner, Olive May,	Amherst.
Turner, William Franklin,	Reading.
Verbeck, Roland Hale,	Malden.
Warner, Theoren Levi,	Sunderland.
Waugh, Thomas Francis,	Worcester.
Wellington, Joseph Worcester,	Waltham.

Wheeldon, Albert James,	Worcester.	
Wheeler, Hermon Temple,	Lincoln.	
White, Herbert Linwood,	Maynard.	
Whiting, Albert Lemuel,	Stoughton.	
Whitmarsh, Raymond Dean,	Taunton.	
Wright, Samuel Judd,	South Sudbury.	
Total,		79

Short Winter Courses.

Abbott, Chester Denning,	Andover.	
Austin, Frank Lee,	Potsdam, N. Y.	
Blair, Alfred Wingate,	Roxbury.	
Browning, Homer Franklin,	Northfield.	
Dorr, Herbert Andrews,	Richmond.	
Dunbar, Frank Andrews,	Richmond.	
Eldridge, Alvah Gorham,	Amherst.	
Farwell, Fred Sherman,	West Fitchburg.	
Gaskell, Edward Thompson,	Amherst.	
Kendrick, Harry Newell,	East Charlemont.	
Kilbourn, Farley Eugene,	Ashburnham.	
Knox, Harry Cobb,	Roxbury.	
Mead, Albert William,	Hartford, Vt.	
Millard, Walter Burton,	Egremont.	
Newcomb, Walter Lemuel,	Brattleboro, Vt.	
Packard, Ransom Clayton,	Brockton.	
Perry, Arthur Asa,	South Pomfret, Vt.	
Phillips, Homer Grant,	Hadley.	
Pick, Fred Mortimer,	Southborough.	
Potter, Lincoln,	Worcester.	
Runkle, Gordon,	Waltham.	
Seely, Will Campbell,	Hamburg, N. J.	
Shaw, Chester Linus,	Brockton.	
Smith, George Clarence,	East Haddam, Conn.	
Smith, Raymond Burr,	Chicago, Ill.	
Stearns, Lynn Lawrence,	Hyde Park, Vt.	
Thayer, Charles Hiram,	Hadley.	
Trufant, Willard Evander,	Abington.	
Twichell, Henry Sessions,	Brookfield.	
Wilder, Frank Everett,	Petersham.	
Wilmarth, Theoph. Williams,	Sunapee, N. H.	
Total,		31

Course in Bee Culture.

Elwell, Maria Huntington,	Brooklyn, N. Y.
French, Jr., Thomas,	Amherst.
Hunt, Justine,	Newton.
Parker, Charles Morton,	Newtonville.
Phelps, Mrs. William Augustus,	Lee.
Smith, Raymond Burr,	Chicago, Ill.
Total,	6

Graduate Courses.

For Degrees of M.S. and Ph.D.

Back (B.Sc., M. A. C., '04), Ernest Adna,	Florence.
Franklin (B.Sc., M. A. C., '03), Henry James,	Bernardston.
Hodgkiss (B.Sc., M. A. C., '03), Harold Edward,	Wilkinsonville.
Hooker (B.Sc., M. A. C., '99), William Anson,	Amherst.
Kibbey (A.B., Harvard, '04), Richards Carroll,	Marshalltown, Ia.
Osmun (B.Sc., M. A. C., '03), Albert Vincent,	Danbury, Conn.
Staples (B.Sc., M. A. C., '04), Parkman Fisher,	Westborough.
Tottingham (B.Sc., M. A. C., '03), William Edward,	Bernardston.
Tower (B.Sc., M. A. C., '03), Winthrop Vose,	Roxbury.
Whipple (B.Sc., Kansas Agr'l College, '04), Orville Blaine,	Olivet, Kan.
Total,	10

Special Students.

Ferguson, Mary Effie Van Everen,	Central Valley, N. Y.
French, Vida Rachel,	Amherst.
Locke, Ada Elsie,	Somerville.
Magoun, Alice Neal,	Bath, Me.

Redding, Charlotte Wilmarth,	Amherst.	
Spaulding, Olive Mary,	Mapleton, Conn.	
Thayer, Lucy Clarke,	Hadley.	
Total,		7

Summary.

Graduate course: —		
For degrees of M.S. and Ph.D.,	10	
Four-years course: —		
Graduates of 1904,	20	
Senior class,	33	
Junior class,	34	
Sophomore class,	56	
Freshman class,	79	
Two-years course: —		
Graduate,	1	
Winter courses,	31	
Bee course,	6	
Special students,	7	
Total,		277
Entered twice,		6
Total,		271

OBJECT.

The leading object of the Massachusetts Agricultural College is "to teach such branches of learning as are related to agriculture and the mechanic arts, . . . in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions in life." That this result may be secured by those for whom it is intended, the college invites the co-operation and patronage of all who are interested in the advanced education of the industrial classes in the Commonwealth.

The instruction here given is both theoretical and practical. The principles of agriculture are illustrated on the extended acres of the farm belonging to the college estate. Nature's work in botany and in horticulture is revealed to the eye of the student in the plant house and in the orchards accessible to all, while the mysteries of insect life, the diseases and the cure of domestic animals, the analysis of matter in its various forms, and the study of the earth itself, "the mother of us all," may engage the attention of the student during the years of his college course.

GRADUATE COURSES.

In response to the increasing demand for advanced work in various directions, the college has arranged for courses of study leading to the degrees of Master of Science and Doctor of Philosophy.

Honorary degrees are not conferred.

Applicants are not eligible to the degree of Master of Science or Doctor of Philosophy until they have received the degree of Bachelor of Science or its equivalent.

The fee for the degree of Master of Science is ten dollars and for the degree of Doctor of Philosophy twenty-five dollars, to be paid to the treasurer of the college before the degree is conferred.

COURSES FOR THE DEGREE OF MASTER OF SCIENCE.

A course of study is offered in each of the following subjects: mathematics and physics, chemistry, agriculture, botany, horticulture, entomology, veterinary medicine. Upon the satisfactory completion of any two of these, the applicant receives the degree of Master of Science.

Candidates for the degree of Master of Science must devote not less than one year and a half after graduation to the prosecution of two studies for the degree, one year of which must be in residence at the Massachusetts Agricultural College.

COURSES FOR THE DEGREE OF DOCTOR OF PHILOSOPHY.

The establishment of courses leading to this degree is the result of many calls for advanced study along certain economic lines neglected in most American universities, and is given only by those departments especially equipped for this grade of study, to graduates of this college or other colleges of good standing. The work required for the degree is intended to be so advanced in its character as to necessitate the greatest industry to complete it, with the belief that such severe requirements will result in the greatest credit to those who are successful. Four courses of study only are therefore open, viz., botany, chemistry, entomology and horticulture as major subjects, though a minor in zoölogy is also available.

At least three years are necessary to complete the work required; twenty hours per week to be devoted to the major subject, while from twelve to sixteen hours per week are required for each of the two minor subjects during one and a half years.

The work in the major and minors will necessarily differ with the previous training and needs of different students, but a general outline of the major in each subject is as follows: —

Botany. — Vegetable physiology, vegetable pathology, mycology, œcology, taxonomy, phylogeny, the history of botany, and the history and theory of evolution. The above subdivisions of botany will be, to a greater or less extent, pursued as necessitated by the previous training of the student and nature of the original problem undertaken. In this course it is also recommended that the student take, in addition to this prescribed minor work, a brief course in the history of philosophy and psychology, which at present will have to be provided elsewhere. Extensive reading of botanical literature, of both a general and specific nature, will be required in certain subjects, and occasional lectures will be given. A botanical conference is held monthly, wherein various new problems touching upon botanical science are considered by graduate students and those of the senior class electing botany. A thesis dealing with some economic problem in plant physiology or pathology, or both, and containing a distinct contribution to knowledge, will also be required.

Chemistry. — Advanced work in the following subjects: inorganic analysis, qualitative, of the rarer elements, and quantitative; crystallography; physical chemistry; descriptive and determinative mineralogy; chemical geology; soil formation; soil physics and chemistry; gas analysis; synthetic inorganic work; chemical theory and history; general organic chemistry; special topics in organic chemistry; elementary quantitative organic analysis; proximate qualitative and quantitative organic analysis, including determination of organic radicles; organic synthesis of aliphatic and aromatic compounds; problems in chemical manufacture; recent chemistry of plant nutrition; animal physiological and pathological chemistry, including foods, standards for feeding of all kinds, and, among secretions, milk and milk industries; and, among excretions, urine and urinalysis; toxicology; insecticides and fungicides; frequent examinations on current chemical literature.

Early in the course original work on some chemical subject pertaining to agriculture must be begun. The history and results of this work must be submitted before graduation, in the form of a thesis containing a distinct contribution to knowledge.

Entomology. — General morphology of insects: embryology; life history and transformations; histology; phylogeny and relation to other arthropods; hermaphroditism; hybrids; parthenogenesis; pædogenesis; heterogamy; chemistry of colors in insects; luminosity; deformities of insects; variation; duration of life.

Œcology: dimorphism; polymorphism; warning coloration; mimicry; insect architecture; fertilization of plants by insects; instincts of insects; insect products of value to man; geographical distribution in the different faunal regions; methods of distribution; insect migrations; geological history of insects, insects as disseminators of disease; enemies of insects, vegetable and animal, including parasitism.

Economic entomology: general principles; insecticides; apparatus; special cases; photography of insects and their work; methods of drawing for illustrations; field work on insects, and study of life histories; insect legislation.

Systematic entomology: history of entomology, including classifications and the principles of classification; laws governing nomenclature; literature, — how to find and use it; indexing literature; number of insects in collections and existence (estimated); lives of prominent entomologists; methods of collecting, preparing, preserving and shipping insects; important collections of insects.

Journal club: assignments of the literature on the different groups of insects to different students, who report at monthly meetings summaries of all articles of value which have appeared during the month.

Required readings of the best articles on the various topics named above, and on the different orders of insects. This reading covers from 15,000 to 20,000 pages in English, French and German, and the candidate is examined on this, together with his other work, at the close of his course.

Thesis: a thesis with drawings, which shall consist of the results of original investigations along one or several lines, and which shall constitute a distinct contribution to knowledge, must be completed and accepted before the final examinations are taken.

Horticulture. — The work in horticulture necessarily varies considerably with different candidates, since its most important features are specialization, original investigation, and the development of individual initiative in dealing with new questions. Each candidate must select some special field of horticultural study, and devote himself continuously to it. He will be required to attend lectures, conferences and seminars dealing with horticulture in its broader aspects. Advanced work will be required in the following subjects: systematic pomology, pomological practice, commercial pomology; systematic, practical and commercial olericulture; greenhouse plants and problems; floriculture; landscape gardening; plant breeding and general evolution; and questions of a physiological nature connected with propagation and pruning.

Other requirements and opportunities are: (1) periodical seminars with special lectures, by prominent men from outside the college; (2) extensive and systematically planned readings; (3) frequent visits to orchards, gardens, greenhouses, estates and libraries outside the college grounds, always with some definite purpose in view; (4) and, finally, the preparation and publication of a thesis setting forth the results of the candidate's major study, which shall be an original and positive contribution to horticultural knowledge.

Zoölogy. — This course is offered as a minor subject for candidates for the degree of Doctor of Philosophy.

General and comparative anatomy, both gross and microscopic; ontogeny and phylogeny; life cycles, metamorphosis and metagenesis; animal associations, colonial, commensal and parasitic, and symbiotic associations of animals and plants; adaptation, adaptive radiation and parallelisms.

Geologic, geographic and bathymetric distribution of animals.

Systematic zoölogy, including palæozoölogy; museum and field technique.

Economic zoölogy.

History and development of zoölogical science.

Weekly seminars and journal club meetings are held, in which all advanced students of zoölogy take an active part.

Collateral reading and a general knowledge of current zoölogical literature are required.

FOUR-YEARS COURSES.

Degree.

Those who complete the four-years course receive the degree of Bachelor of Science, the diploma being signed by the governor of Massachusetts, who is the president of the corporation.

Regular students of the college may also, on application, become members of Boston University, and upon graduation receive its diploma in addition to that of the college, thereby becoming entitled to all the privileges of its alumni, provided that the candidate, in addition to the college course, shall have mastered in a preparatory school a three-years preparatory course in studies beyond those commonly presented in the grammar schools of Massachusetts.

ADMISSION.

Every candidate for admission must be at least sixteen years of age, and must present a testimonial of good character from the principal of the last school that he attended.

Certificates. — Certificates of schools and academies approved by the faculty of the college are accepted in place of examinations. These certificates must be made out on blanks furnished on application to the registrar, and must be signed by the principal of the school making such application.

A student admitted on certificate may be dropped from college at any time during freshman year when his work is not satisfactory; and the privilege implied in the acceptance of a certificate may be revoked whenever, in the judgment of the faculty, it is not properly exercised.

Examinations. — Candidates for admission to the freshman class will be received on certificate, as explained above, or on examination in the following subjects: algebra (through quadratics), plane geometry, English, general history, civil government (Mowry's "Studies in Civil Government"), physiology (Martin's "The Human Body," briefer course), physical geography (Guyot's "Physical Geography," or its equivalent).

This examination may be oral or written; the standard required for admission is 65 per cent. in each subject. Knowledge of the principles of arithmetic is presupposed, although an examination in this subject is not required. Teachers are urged to give their pupils such drill in algebra and geometry as shall secure accuracy and readiness in the application of principles to practical examples.

A candidate will not be accepted in English whose work is notably deficient in point of spelling, punctuation, idiom or division into paragraphs. The candidate will be required to present evidence of a general knowledge of the subject matter of the books named below, and to answer simple questions on the lives of their authors. The form of examination will usually be the writing of a paragraph or two on each of several topics to be chosen by the candidate from a considerable number — perhaps ten or fifteen — set before him in the examination paper. The treatment of these topics is designed to test the candidate's power of clear and accurate expression, and will imply only a general knowledge of the substance of the books. The books set for the examination in 1905 and 1906 are: Shakespeare's "The Merchant of Venice;" Goldsmith's "The Vicar of Wakefield;" Scott's "Ivanhoe;" Tennyson's "The Princess;" Lowell's "The Vision of Sir Launfal;" George Eliot's "Silas Marner."

Examinations in one or more of the required subjects may be taken a year before the candidate expects to enter college, and credit for successful examination in any subject will stand for two years after the examination.

Candidates for classes more advanced than the freshman class will be examined in the studies gone over by the class to which they desire admission.

The examinations for admission in 1905 will be held at the Botanic Museum of the Agricultural College in Amherst on Thursday and Friday, June 22 and 23, and on Tuesday and Wednesday, September 19 and 20, as follows: —

First Day.

8.30 A.M. — Registration.
9 A.M. — English.
11 A.M. — General history.
2 P.M. — Geometry.

Second Day.

9 A.M. — Civil government.
10 A.M. — Algebra.
2 P.M. — Physiology.
3 P.M. — Physical geography.

Entrance examinations in June will be held on the same days and in the same order as in Amherst: at Jacob Sleeper Hall, Boston University, 12 Somerset Street, Boston; at Horticultural Hall, Worcester; and at Pittsfield, but candidates may be examined and admitted at the convenience of the examiners, at other times in the year, but not during the summer vacation.

ENTRANCE EXAMINATION PAPERS USED IN 1904.

The standard required is 65 per cent. on each paper.

ALGEBRA.

1. Factor $\frac{8}{x^3}-27y^6$.

Factor $a^2x^3-\frac{8a^2}{y^3}-x^3+\frac{8}{y^3}$.

2. Simplify $\dfrac{1-a^2}{(1+ax)^2-(a+x)^2}\div\dfrac{1}{2}\left\{\dfrac{1}{1-x}+\dfrac{1}{1+x}\right\}$.

3. $\dfrac{7+x}{3}=\dfrac{9+y}{5}=\dfrac{11+x+y}{7}$. Solve for x and y.

4. $\left\{(x)\left(\sqrt[n]{x^{-\frac{1}{n}}}\right)\right\}^{\frac{n^2}{1-n}}$. Express with positive exponents, and reduce to lowest terms.

5. Find square root of the binomial surd $4-\sqrt{15}$.

6. $\left\{\dfrac{x+\sqrt{x^2-9}}{x-\sqrt{x^2-9}}\right\}^{\frac{1}{2}}=x-2$. Solve for x.

7. $\left\{\begin{array}{l}\dfrac{1}{x^2}+\dfrac{1}{y^2}=65\\[2mm]\dfrac{1}{x}-\dfrac{1}{y}=11\end{array}\right\}$. Solve for x and y.

8. $\left\{\begin{array}{r}xy+xy^2=12\\x+xy^3=18\end{array}\right\}$. Solve for x and y.

GEOMETRY.

1. Prove: in any triangle, the product of any two sides is equal to the product of the segments of the third side formed by the bisector of the opposite angle, plus the square of the bisector.

2. The diameters of two concentric circles are 14 and 50 units, respectively; find the length of the chord of the greater circle which is tangent to the smaller.

3. Prove: two rectangles having equal altitudes are to each other as their bases. Prove case of incommensurable bases only.

4. Prove: two similar triangles are to each other as the squares of homologous sides.

5. The side of an equilateral triangle is 6; find the areas of its inscribed and circumscribed circles.

PHYSICAL GEOGRAPHY.

1. Describe the general arrangement of the mountain ranges in North America. How have they influenced the form of the continent? What two agencies have caused its irregularity of outline? Give examples illustrating each.

2. What do you mean by youth, maturity and old age on the part (*a*) of a river; (*b*) of a mountain range; (*c*) of a sea coast? Give the characteristics of each, with examples, preferably such as you have actually seen.

3. Locate and describe the prairies and the great plains, and tell for what industries each is best fitted. Describe also the great desert of the south-west, with its type of vegetation. By what means, if at all, can this desert be made to support mankind?

4. Distinguish between climate and weather. What factors influence the climate of a place? Compare that of Marseilles with that of Portland, Me., and in the same way the climate of London with that of Labrador.

5. Describe a glacier, its origin, moraines and glacial erosion. Are any glaciers found within the limits of the United States; if so, where? Describe the Greenland ice sheet, and tell what evidences we have that such a sheet once covered a part of North America. Give its probable cause, limits and direction of flow.

6. What are the various influences, geographical and climatic, which govern the distribution and migrations of animals and of mankind?

CIVIL GOVERNMENT.

1. Name the four forms through which the government of this country has passed. Explain these four forms. In what year did each end?

2. Write upon any (six) of the following topics. Accuracy of statement and fulness of detail are important in this work.

(*a*) The preamble to the Constitution of the United States.

(*b*) The legislative department of the State of Massachusetts.

(*c*) The legislative department of the United States government.

(*d*) The present way of choosing the President of the United States.

(*e*) The present way of choosing United States Senators.

(*f*) The executive departments of the United States government.

(*g*) The national bank system.

(*h*) The Louisiana purchase and its results.

PHYSIOLOGY.

1. Define an organ, a tissue, a cell. How may the tissues be classified? What do you mean by physiological division of labor? Illustrate.

2. Compare the blood and lymph. Where does the latter come from and where does the surplus lymph go, and what carries it there? What is the value of the lymph to the various tissues and organs?

3. Describe carefully the human arm, naming the different sorts of tissues found therein, the various bones and their joints, the different levers, and finally the uses of the arm, telling how it is adapted to these uses in comparison with the fore limb of a horse or dog.

4. Compare the veins, arteries and capillaries, with reference to their coats, muscular development, valves and elasticity. What is the pulse, and why is there no pulse in the veins? What causes the blood to flow in the veins?

5. What do you mean by digestion, by absorption, by assimilation? Where and by aid of what juices are the following substances digested: fats, starch and proteids? How do the digested substances get to the tissues which need them, and how are they utilized?

6. Give as fully as you can the anatomy and physiology of the ear, — the external ear, the tympanum, eustachian tube, semicircular canals and the cochlea.

GENERAL HISTORY.

1. Into what three periods may we divide our study of history? Give as closely as you can the limits of each period, with the reasons for your answer.

2. Describe some of the manners and customs of the early Spartans.

3. Give some of the causes, leaders, chief events and results of the Punic wars.

4. With what do we associate these names: Marathon, Lycurgus, Aristotle, Alexander the Great, Attila, Charlemagne, Peter the Great, the Vandals, Châlons, Richelieu?

5. Tell what you can of the crusades, speaking of their causes, objects, leaders and results.

6. During the Dark Ages two great institutions arose, — the papacy and feudalism. Explain them.

7. Give a brief outline of the Norman conquest of England, telling how it came to pass, what the chief battle was, and the effect on the conquered country.

8. The French revolution: its causes and results.

9. What was the English civil war? Explain its causes, and speak of the great leader it developed.

10. Tell about the Louisiana purchase; by whom made, with what results, and of what especial significance just now.

ENGLISH.

NOTE. — Penmanship, punctuation and spelling are considered in marking this paper. The time allowed is two hours.

1. Choose two of the following topics, and write clearly and interestingly upon them. Let each essay be about two hundred words in length.

(*a*) The boyhood of Shakespeare.
(*b*) Shakespeare in London.
(*c*) An outline of Goldsmith's life.
(*d*) Goldsmith's rank in English literature.
(*e*) What Scott did for the English novel.
(*f*) Scott's last days.
(*g*) Lowell's life abroad.
(*h*) Lowell's early surroundings.
(*i*) An outline of Tennyson's life.
(*j*) George Eliot's early days.

2. Choose any five from the following list of subjects, and write a paragraph or two on each subject chosen. Give title in each case.

(*a*) The lesson of the caskets in the "Merchant of Venice."
(*b*) Some interesting characters in the "Vicar of Wakefield."
(*c*) The character of Richard Cœur de Lion, as depicted in "Ivanhoe."
(*d*) Early England, as shown in "Ivanhoe."
(*e*) Tell the story of "The Princess."
(*f*) The great lesson in "The Vision of Sir Launfal."
(*g*) The influence of little Eppie on the character of Silas Marner.

COURSES OF INSTRUCTION FOR THE DEGREE OF BACHELOR OF SCIENCE.

AGRICULTURE.

Introductory: relations of federal and State governments to agriculture, four lectures; history of agriculture, tenure of land, rents, holdings, etc., six lectures.

Freshman year, first semester, three hours a week, required. Animal breeding. Shaw's "Breeding Animals," lectures and discussion of principles of breeding. — Assistant Professor COOLEY.

Sophomore year, seven weeks, first semester, four exercises a week in class room, required. Breeds of farm live stock: sheep, cattle. Lecture syllabus by Cooley, and Curtis's "Horses, Cattle, Sheep and Swine." — Assistant Professor COOLEY.

Sophomore year, nine weeks, first semester, four exercises a week in class room, required. Horses and swine. Lecture syllabus by Cooley, and Curtis's "Horses, Cattle, Sheep and Swine." — Assistant Professor Cooley.

Sophomore year, eight weeks, second semester, three hours a week, required. Dairying. Lectures on dairy farming, milk production, handling and marketing of milk, milk preservation and modification, and products of milk. Text-book, Wing's "Milk and its Products." — Assistant Professor Cooley.

Sophomore year, ten weeks, second semester, required. Soils: formation, classification, composition; physical and chemical characteristics, and their relations to maintenance and increase in productiveness. Brooks's "Agriculture," Vol. I., supplemented by lectures and laboratory work. — Professor Brooks.

Junior year, ten weeks, first semester, elective. Methods of soil improvement, including tillage, drainage and irrigation. Brooks's "Agriculture," Vol. I., supplemented by lectures, laboratory work and practical exercises. — Professor Brooks.

Junior year, four weeks, first semester, elective. Manures: production, composition, properties, adaptation and use. Brooks's "Agriculture," Vol. II., supplemented by lectures and practical exercises. — Professor Brooks.

Junior year, four weeks, first semester, elective. Stock judging. — Assistant Professor Cooley.

Junior year, second semester, elective. Fertilizers, including a critical study of their production, composition, properties, adaptation and use; and green manuring. Brooks's "Agriculture," Vol. II., supplemented by lectures, laboratory work and practical exercises. — Professor Brooks.

Senior year, four weeks, first semester, four hours a week, elective. Silos and ensilage: historical development; the merits and methods of construction of the different kinds of silos; the crops suited for ensilage; ensilage machinery; the methods of filling the silo; and the nature and extent of the changes taking place in ensilage as affecting food value. Lectures, books of reference and practical exercises. — Professor Brooks.

Senior year, seven weeks, first semester, four hours a week, elective. Feeding animals: principles of digestion and animal nutrition, a study of feeding stuffs (coarse and concentrated). The relation of food to product; compounding rations. Armsby's "Cattle Feeding," lectures and discussion. — Assistant Professor Cooley.

Senior year, seven weeks, first semester, four hours a week, elective. Dairying: selection and management of the dairy farm, dairy cattle, chemical and physical properties of milk, etc., cream, butter, cheese and by-products. — Assistant Professor COOLEY.

Senior year, first and second semester, two exercises a week, for ten weeks. Dairy practice: use of separators, Babcock tester, butter making, etc. — SPECIALISTS.

Senior year, second semester, elective. The crops of the farm and crop rotation; including a study of the origin and agricultural botany of all the leading crops of the farm, — annual forage crops, grasses and legumes, cereals, root crops, vegetables, tobacco and other special commercial crops; the production and use of each; the varieties and methods of improvement; the adaptation to soil; the special manurial requirements and the methods of raising and harvesting are considered. Lectures, reference books and field work. — Professor BROOKS.

Senior year, second semester, elective. Agricultural experimentation: objects, methods, sources of error; interpretation of results. Lectures and study of reports, bulletins, etc. — Professor BROOKS.

Senior year, second semester, elective. Farm management: selection of the farm, its subdivisions and equipment, buildings, fences, roads, water supply; farm capital, permanent, perishable and floating; the labor of the farm and its management; farm power and farm machinery. Lectures and practical exercises. — Professor BROOKS.

Seminar courses, by arrangement, for advanced students.

Special problems requiring experiment or other research investigation will be assigned to students fitted for and desiring such work.

Training and practice in the use of farm implements and machines by arrangement when desired.

HORTICULTURE.

This department endeavors to give the student a working knowledge of horticulture on its practical and on its scientific side. The attempt is made to inculcate a taste and an enthusiasm for horticultural pursuits, in place of distaste and dislike for the drudgery of farm life. On these things success and further progress chiefly depend.

The courses now offered are as follows, though others will be added as occasion requires: —

1. Sophomore class, second semester. The fundamental opera-

tions of horticulture, — propagation, pruning and cultivation, — as related to the physiology of the plant. During the first half of this course Bailey's "Nursery Book" is used as a text. — Mr. **GREENE.**

2. Junior year, first semester. Pomology: this course covers the three natural divisions of the subject, viz.: (*a*) systematic pomology, or the study of the fruits themselves; (*b*) practical pomology, or the practice of fruit growing; (*c*) commercial pomology, or the principles underlying the marketing of fruits. The course is pursued by means of text-book, lectures, laboratory and field exercises. — Mr. **GREENE.**

3. Junior year, first semester, four periods weekly. Plant breeding: based on a thorough examination of the laws of heredity and of variation, and of the principal theories of evolution. Lectures, accompanied by practice and direct experiments in crossing and hybridizing plants. — Professor **WAUGH.**

4. Junior year, second semester, four periods weekly. Market gardening, including vegetables and small fruits; locations, soils, methods of cultivation and marketing. Text-book, Bailey's "Principles of Vegetable Gardening," lectures and field exercises. — Mr. **GREENE.**

5. Individual problems will be assigned to seniors who elect horticulture. This gives the student an opportunity for specialization in various lines of fruit growing, vegetable culture, greenhouse management, landscape gardening, etc. — Professor **WAUGH,** Mr. **GREENE** and Mr. **CANNING.**

A seminar, made up of all students electing advanced work in horticulture or landscape gardening, meets at regular intervals for the discussion of any matters pertaining to the subject. Successful and noted horticulturists from outside the college are frequently present at these meetings, to speak on the topics with which they are especially identified.

Landscape Gardening.

The college wishes to promote the work in landscape gardening in every way possible. The aim of the courses is to give the general student an understanding of the fundamental principles of design and of good taste as applied to gardening, and to prepare advanced students for the practice of landscape gardening in its various branches.

Although a variety of other work along related lines is available, the courses now definitely offered are as follows: —

1. Junior year, four periods weekly. Materials: this course is designed to give the student an intimate acquaintance with the trees, shrubs and other plants used in landscape gardening. — Professor WAUGH and Mr. CANNING.

2. Junior year, second semester, four hours a week. Elements of landscape design: the fundamental principles underlying the artistic development of parks, estates, gardens and other areas, together with some of the simpler applications to practical conditions. During the first half of the term Waugh's "Landscape Gardening" will be used as a text. — Professor WAUGH.

3. Senior year, first and second semesters, four laboratory periods weekly. Advanced landscape gardening: lectures, conferences, field exercises and extensive practice work with criticism. The student is given definite problems to solve, these problems being arranged in such an order as to develop the subject logically in the student's mind. — Professor WAUGH and Mr. CANNING.

CHEMISTRY.

This course aims to inculcate accurate observation, logical thinking, systematic and constant industry, together with a comprehensive knowledge of the subject. Instruction is given by text-book, lectures and a large amount of laboratory work under adequate supervision. The laboratory work at first consists of a study of the properties of elementary matter, analysis of simple combinations and their artificial preparation. This is followed by a quantitative analysis of salts, minerals, soils, fertilizers, animal and vegetable products. The advanced instruction takes up the chemistry of various manufacturing industries, especially those of agricultural interest, such as the production of sugar, starch and dairy products; the preparation of animal and plant foods, their digestive assimilation and economic use; the official analysis of fertilizers, fodders and foods; and the analysis of soils, waters, milk, wine and other animal and vegetable products.

The courses are as follows: —

Freshman year, second half of second semester, four hours a week. General chemistry, part 1, principles of chemistry, non-metals. Newth's "Inorganic Chemistry." — Assistant Professor HOWARD.

Sophomore year, first semester, six hours a week. General chemistry, part 2, metals. — Assistant Professor HOWARD.

Second semester, five hours a week. Subject continued; dry analysis. — Assistant Professor HOWARD.

Junior year, first semester, eight hours a week. Qualitative and quantitative analysis; organic chemistry. Four hours a week, special subject. — Professor WELLINGTON.

Second semester, ten hours a week. Organic chemistry. Remsen's "Organic Chemistry." Five hours a week, special subject. — Professor WELLINGTON.

Senior year, elective, first semester, three hours a week. Chemical industries. — Professor GOESSMANN.

Eight hours a week, quantitative analysis and physical chemistry. Reychler-McCrae's "Physical Chemistry." — Professor WELLINGTON and Assistant Professor HOWARD.

Second semester, eight hours a week. Advanced work, with lectures. — Professor WELLINGTON.

GEOLOGY.

1. Mineralogy, junior year, first semester, six weeks, three hours a week. A course of systematic determinative mineralogy, based on Brush's "Manual." This work is carried on in the laboratory, and consists in determining the minerals by a study of lustre, fusibility, hardness, color, streak, specific gravity, etc., and by some of the simpler chemical tests. — Assistant Professor HOWARD.

2. Geology, junior year, second semester, twelve weeks, three hours a week. Structural, dynamical, physiographical and historical, based upon Scott's "Introduction to Geology." The course aims to give a review of the physical condition of the earth; the various dynamic agencies, and the results of their activities; the origin and structure of the rocks; and, finally, the geological history of the globe, and the appearance in time and the development of the principal races of animals and plants. The museum, lantern slides and the classic Connecticut valley afford ample means for illustration. — Professor LULL.

ZOÖLOGY.

1. Anatomy and physiology, freshman year, one-half of the second semester, four hours a week. A text-book, Martin's "The Human Body," advanced course, is used, from which daily recitations are assigned, supplemented by demonstrations from the charts and models and from microscopic and other preparations. The fact that the subject is required for entrance makes it possible in a comparatively brief period to review the main features

of human anatomy, the generally accepted views concerning the physiology of the various organs, and the more essential laws of health; and, aside from the practical value of the last, the knowledge of the human system thus gained aids greatly in the zoölogical work to come. — Professor LULL.

2. Zoölogy, sophomore year, first semester, two periods a week. This is mainly a laboratory course, the aim being to familiarize the student with the structure of a number of typical forms, representative of the chief phyla of the animal kingdom, to train him to more precise habits of observation, and to lay the foundation for a more thorough understanding of laboratory technique. Lectures, amply illustrated by specimens, charts and lantern slides, supplement and render orderly the knowledge gained in the laboratory. — Professor LULL.

3. Zoölogy, elective, junior year, four periods a week. A course in comparative morphology and systematic zoölogy, based upon Parker and Haswell's "Text-book of Zoölogy." Opportunity is given for the careful dissection of each of the typical forms or its equivalent, described in the text, with a further series of animals for comparative study. Special attention is paid to individual and racial development, adaptation, relationship of animals to one another and to plants, geological and geographical distribution of animals, and the economic importance of the different groups, except the insects, both living and extinct. The lectures are illustrated by the very complete museum collection. — Professor LULL.

POLITICAL SCIENCE.

The purpose of the entire course is to fit the student to understand the economic and political movements of his time, so that he may successfully solve the problems confronting him.

Economics, junior year, first semester, four hours a week. (1) The elements of political economy are taught by means of textbook (this year Henry Rogers Seagen's "Introduction to Economics") and lectures, the aim being to make the student familiar with the generally accepted facts, definitions, principles and laws of the science; and to train him to criticise theories, scrutinize facts and weigh arguments. (2) The industrial history of England and of the United States is studied. Gibbins's "Industrial History of England" is used. (3) The following elective courses are offered: economics of agriculture; banks and banking; problems of the currency; trusts or monopolistic corporations; transportation; socialism. (4) Practical economics. Each member of the class selects for investigation a question in which he is interested, and devotes two or three months to its solution.

Papers giving the results of research, prepared by members of the class, are read and discussed by the students. Each student is asked to explain and defend from criticism the statements and the conclusions made in the paper he presents. The department has at its disposal a working library and a collection of material for the use of students. — Professor WALKER.

Constitution of the United States, senior year, four hours a week during the last half of the first semester and the whole of the second semester. (1) Political institutions. By use of text-book (Albert Bushnell Hart's "Actual Government") and lectures the student is led to understand what is the government, municipal, State and federal, now existing in the United States. This government is compared and contrasted with the governments of England, France and Germany. Care is taken to familiarize the student with the practical methods of legislation, of nominating conventions, of elections and of administration. Woodrow Wilson's "The State" is used as a book of reference. (2) Constitutional history of the United States, with discussions relating to the origin, nature, scope and purpose of government. Bancroft's "History of the Constitution of the United States" is used as a book of reference. — Professor WALKER.

Lectures on law, second semester, one hour a week. This course treats of laws relating to business, especially to business connected with rural affairs, citizenship, domestic relations, farming contracts, riparian rights, real estate and common forms of conveyance. Practical work is required, such as may fit one to perform the duties of a justice of the peace. — Mr. LYMAN.

ENGLISH.

This department aims to secure: (*a*) ability to give written and oral expression of thought in correct, effective English; (*b*) acquaintance with the masterpieces of American and English literature; (*c*) ability to present, logically and forcibly, oral and written arguments on propositions assigned for debate.

The following courses are offered: under (*a*) rhetoric and oratory; under (*b*) American literature and English literature; under (*c*) argumentation. The elective course in senior year is in language and literature.

1. *Rhetoric.* — This course extends through the two semesters of freshman year and through the second semester of sophomore

year. In the first semester of freshman year work is confined to essay writing and to personal criticism, by the instructor, of the students' compositions. This criticism is offered at stated intervals to each student individually, according to a posted schedule of appointments. At the beginning of the semester necessary information with regard to the preparation of essays is furnished each student. In the second semester of freshman year the study of literary types is undertaken in the form of class room work in prose composition, including exposition, persuasion, narration, description, and in prose diction, including usage and style. Special attention is given to the training of the inventive ability of the student. The text-book used is Baldwin's "College Manual of Rhetoric." In the second semester of sophomore year individual work in essay writing is again taken up, largely based upon the previous work of the class in American literature (see 3, below). Here also personal criticism is offered. — Assistant Professor BABSON.

2. *Oratory.* — Individual drill in declamation, first in private and then before the class, is given during the second semester of freshman year. The choice of speakers for the Burnham prizes is based upon this work. In the junior year, during the first semester, at least two orations, upon subjects assigned or chosen, are written, and delivered before the class. Every oration is criticised by the instructor before it is committed to memory by the student. The choice of speakers for the Flint prizes in oratory is based upon this work. — Assistant Professor BABSON.

3. *Literature.* — American literature is studied in the first semester of sophomore year, four hours a week. The course comprises, first, the careful study of a text-book (Newcomer's "American Literature"), together with recitations based upon the same; secondly, the taking of notes from lectures, dwelling upon topics not fully treated in the text-book; and, thirdly, the reading outside of the class room of assigned selections from the prose and poetical works of standard American authors. — Assistant Professor BABSON.

The history of English literature is studied during the second semester of sophomore year, four hours a week. The work is based upon a text-book, this year Johnson's "History of English and American Literature." The topical method is followed in recitation, and, instead of formal lectures, there are discussions of points requiring a fuller development than the text-book gives. Collateral readings of literature are required. Frequent written tests are given, in which particular attention is given to (*a*) the definition of words used in the text-book; (*b*) the use of English in the development of the topics unfolded in the text-book or discussed in the class room. — Professor MILLS.

4. *Argumentation.* — Four hours a week during the first semester of junior year are given to written and oral argumentation. The course is outlined as follows: (*a*) principles of argumentation as laid down in a text-book or by lecture; (*b*) briefs and brief-making; (*c*) briefs developed into forensics and submitted for personal criticism; (*d*) debates. — Professor MILLS.

Senior elective course, two semesters, four hours a week. The work in this course is upon the following subjects: (*a*) English language, its origin, history and development, with particular attention to the study of words as outlined in Anderson's "A Study of English Words;" (*b*) English literature, principally of the eighteenth and nineteenth centuries. — Professor MILLS.

VETERINARY SCIENCE.

The course of instruction in veterinary science has been arranged to meet the demands of the students who, after graduation, purpose following some line of work in practical agriculture. Particular stress is laid upon matters relating to the prevention of disease in animals. In addition, the interests of prospective students of human and comparative medicine have been taken into account in the arrangement of the course of study. The subject is taught by lectures, laboratory exercises, demonstration and clinics.

Senior year, elective, first semester, four hours a week. Veterinary hygiene, comparative (veterinary) anatomy, general pathology. — Professor PAIGE.

Second semester, four hours a week. Veterinary materia medica and therapeutics; theory and practice of veterinary medicine; general, special and operative surgery; veterinary bacteriology and parasitology; medical and surgical clinics. — Professor PAIGE.

The instruction in bacteriology is given by means of lectures, recitations and laboratory exercises. The object of this course of study is to acquaint the student with the various organisms found in air, water, soil, milk and the body, and their relation to such processes as decomposition, fermentation, digestion and production of disease. The toxic substances resulting from the growth of organisms are considered, as well as the antitoxines used to counteract their action.

Senior year, first half of the first semester, four laboratory exercises, of two hours each a week, required. — Professor PAIGE.

BOTANY.

The object of the course in botany is to teach those topics pertaining to the science which have a bearing upon economic and scientific agriculture. The undergraduate work extends through six semesters. The first two semesters are required. An outline of the course follows: —

Freshman year, first semester, five hours a week. Laboratory work and lectures; histology and physiology of the higher plants. This includes a study of the minute structure of the plant organism, such as stems, roots, leaves, seeds, etc., and of their functions and chemical and physical properties. This course extends into the next semester. — Mr. FRANKLIN.

Freshman year, second semester, three hours a week. Laboratory work, lectures and text-book; outlines of classification and morphology of the higher plants. This course follows the preceding one, and commences about the first of March. It is devoted to a study of the relationship of plants, their gross structure, together with extensive individual practice in flower analysis. An herbarium of two hundred species of plants is required. — Mr. FRANKLIN.

Junior year, first semester, five hours a week. Two laboratory exercises and one lecture period a week. Cryptogamic botany. This includes a study of the lower forms of plant life, and is necessary for a comprehension of the following courses. — Mr. FRANKLIN.

Junior year, second semester, five hours a week. Two laboratory exercises and one lecture period a week. Elements of vegetable pathology and physiology. This course includes a study of the common fungous diseases of crops, and consideration of the method of prevention and control of the same. The plant's function as related to susceptibility to disease is also taken up. All of the junior botany is included in four of the junior elective courses. — Professor STONE.

Senior year, elective, both semesters. Three laboratory exercises and one lecture period a week. (*a*) Plant physiology; (*b*) plant pathology. Either course is optional. This course is adapted to students who desire a more detailed knowledge of plant diseases and plant physiology. Extensive use is made of the valuable and constantly increasing experiment station literature. — Professor STONE.

MATHEMATICS, PHYSICS AND ENGINEERING.

This department has charge of the instruction in mathematics, physics, civil engineering and drawing. The aim is to secure thorough work in the fundamental principles, and train the mind in clear and logical thinking. The application of the subjects to practical problems is given special attention. The work of the department extends over the four years, as outlined below.

Mathematics.

Freshman year, first semester, five hours a week. Higher algebra, including ratio and proportion, progressive binomial theorem, series undetermined coefficients, logarithms, continued fractions, permutations. Wells' "College Algebra." — Professor HASBROUCK.

Second semester, two hours a week. Solid geometry. Wells' "Solid Geometry."— Professor HASBROUCK.

Plane trigonometry, two hours a week. Phillips and Strong's "Elements of Trigonometry." — Professor OSTRANDER.

Junior year, for mathematical and chemical students, first semester, four hours a week. Analytic geometry of the line, circle, conic sections and higher plane curves. Nichols' "Analytic Geometry." — Professor OSTRANDER.

Second semester, four hours a week. Differential and integral calculus. Osborne's "Calculus." — Professor HASBROUCK.

Physics.

Sophomore year, first semester, four hours a week. Elementary mechanics of solids, liquids and gases, heat and sound. Dana's "Elementary Mechanics," Carhart's "University Physics." — Professor HASBROUCK.

Second semester, four hours a week. Electricity, magnetism and light. Carhart's "University Physics." — Professor HASBROUCK.

Senior year, elective for those students who have taken junior mathematics; first semester, four hours a week. Analytic mechanics. Peck's "Analytic Mechanics." — Professor HASBROUCK.

Second semester, four hours a week. Laboratory work. — Professor HASBROUCK.

Civil Engineering and Surveying.

Sophomore year, second semester, two exercises of two hours a week. Plain surveying with field work, including the use of the usual surveying instruments. Barton's "Surveying." — Professor OSTRANDER.

Instruction in civil engineering will be given in two distinct courses of one year each, the courses alternating. They will be open to students of the junior and senior classes as indicated below. The course for 1904–05 will be for students in mathematics only. First semester, three hours' recitation and two hours' draughting a week. Stresses in roofs, bridges and graphic statics. Merriman and Jacoby's "Roofs and Bridges," Parts I. and II.

Second semester, four hours a week. Hydraulics and sanitary engineering. Merriman's "Hydraulics and Lectures." — Professor OSTRANDER.

The course of 1905–06 will be required of juniors and seniors taking the courses in mathematics and landscape gardening.

First semester, four hours a week. Strength of materials, foundations and masonry construction. Text-book and lectures. — Professor OSTRANDER.

Second semester, three hours' recitation or lectures and two hours' field work or draughting a week. Topographic and higher surveying, highway construction, the measurement of earth work, pavements and railroad construction. Text-book and lectures. — Professor OSTRANDER.

Drawing.

Junior year, first semester, two two-hour sessions a week for students in mathematics and landscape gardening; free-hand drawing.

Second semester, two two-hour sessions a week. Mechanical and topographic drawing.

ENTOMOLOGY.

The importance of a knowledge of insects in every department of life is recognized by placing an introductory course in this subject as a required study in the junior elective courses: (1) agriculture, (2) horticulture, (3) biology, (4) landscape gardening. For those who desire a further knowledge of it, because of its importance to their future occupations, a senior elective is offered, so shaped as to be of especial value for those who expect to take up agriculture, horticulture, landscape gardening, forestry or science teaching as life occupations.

Junior year, second semester, four exercises a week, of two hours each. Lectures, laboratory and field work; general consideration of insect structure and life histories; systematic study of the groups of insects, with particular reference to those of economic importance; methods for preventing or checking their ravages; insecticides and apparatus for their use; the collecting, mounting and naming of insects, and examination of the work of insects in the field and laboratory. — Professor H. T. Fernald.

Senior year, elective, first and second semesters, four laboratory exercises of two hours each a week. Lectures, laboratory and field work; advanced morphology of insects; economic entomology; training in the determination of insects; use of literature on entomology; study of life histories; value and application of insecticides; thesis on insects most closely related to future occupation of the student. — Professors C. H. Fernald and H. T. Fernald.

Modern Languages.

French. — Course I.: requires, for the two semesters of the freshman year, four hours a week first semester, four hours a week second semester. The aim of this course is to enable the student to read modern French fluently, especially that found in scientific journals and treatises. The first ten weeks are devoted to gaining a thorough mastery of the accent, and such principles of grammar and syntax as are covered by the first half of Whitney's "French Grammar." Great stress is laid upon the acquisition of a correct accent, a good vocabulary, and a thorough comprehension of the main idiomatic difficulties of the language. This course is further strengthened by constant drill in pronunciation, exercises and composition. — Mr. Herrick.

Course II.: elective for both semesters of the senior year, four hours a week. The aim of this course is to equip the student with a general knowledge of classical literature, and a working knowledge of the language as it is spoken and written in the French capital to-day. Drill is furnished in composition, principles of syntax and sight translation. Students electing Course II. must have a good record in Course I., or must pass a satisfactory examination therein. — Mr. Herrick.

Spanish. — Given this year as a special elective for both semesters, four hours a week. The special aim is to enable students planning future fields of work in Spanish-speaking countries to acquire sufficient speaking and writing knowledge of the Castilian dialect to enable them to start to best advantage. Especial attention is given to conversation, the method employed being that found in Marion and Garennes' "Introdución á la Lengua Castellana." Grammar rudiments, accent and idiomatic difficulties are thoroughly studied; the acquisition of a good working vocabulary is insisted upon, and the course is further strengthened by practice in writing from dictation, constant drill in pronunciation, exercises and composition, and the reading of books characteristic of modern Spanish life and customs. — Mr. HERRICK.

German. — Course I.: required for both semesters of sophomore year, four hours a week first semester, three hours a week second semester. An understanding of the rudiments of grammar, facility in translation and an ability to pronounce the language and to understand simple spoken German are the main objects in view. — Assistant Professor BABSON.

Course II.: elective for both semesters of senior year, four hours a week. Special attention is given to the reading of German, particularly to German of a scientific nature. Work is also required in prose composition throughout the year. Accuracy in pronunciation, the ability to understand German as spoken in the class room, and to converse within reasonable limits, are also features of this course. Students electing Course II. must have a good record in Course I., or must pass a satisfactory examination therein. — Assistant Professor BABSON.

MILITARY SCIENCE.

In compliance with the provisions of an act of Congress of July 2, 1862, military instruction under a regular army officer, detailed for this purpose, is required of all able-bodied male students. Men are excused from attendance upon the exercises of this department only on a surgeon's certificate, given by Dr. Charles F. Branch, the college physician.

The object of such instruction is clearly to disseminate the elements of military knowledge throughout the country, that, in case of sudden emergency, a sufficient number of well-trained, educated men may be found to command and properly to instruct volunteer troops. Military drill also has the object in view of giving the student physical exercise, teaching respect and obedience to those in authority without detracting from pride of manhood, and developing a military bearing and courtesy becoming in a citizen as in a soldier.

In order to further stimulate the study of military science in colleges, the War Department issued General Orders, No. 6, dated Washington, D. C., Aug. 24, 1903, as follows: —

> The reports of the regular inspections of the colleges and schools to which officers of the army are detailed, in pursuance of law, as principals or instructors, will annually hereafter be submitted to the general staff for its critical examination, and the chief of staff will report to the Secretary of War, from the institutions which have maintained a high standard, the six institutions whose students have exhibited the greatest interest, application and proficiency in military training and knowledge. The President authorizes the announcement that an appointment as second lieutenant in the regular army will be awarded to an honor graduate of each one of the six institutions, provided sufficient vacancies exist after caring for the graduates of the military academy at West Point and the successful competitors in the annual examination of enlisted men. . . .
>
> By order of the Acting Secretary of War,
>
> S. B. M. YOUNG,
> *Lieutenant-General, Chief of Staff*

Course I.: out of doors, an exercise of one hour, three times a week, Mondays, Tuesdays and Thursdays; infantry drill by squad, company, and battalion; guard mounting, dress parade, inspection and review; artillery drill by detachment; target practice. A guard is mounted five times in each week, and the guard maintained under practical instruction for one hour in each exercise.

All drills are in the drill hall during the winter months and inclement weather.

Students assigned to the college band are given instruction and practice in band music and band evolutions, in place of drills and recitations.

Course II.: theoretical instruction for freshmen, one hour a week for both semesters, comprises recitations in infantry drill regulations; "United States Service Manual."

Course III.: theoretical instruction for seniors for both semesters, one hour a week, embraces drill and army regulations; duties of sentinels and guard duty, elements of military science, preparation of necessary reports and returns pertaining to a company of infantry, and a thesis on some military subject; Wagner's "Elements of Military Science." — Major ANDERSON.

SYNOPSIS OF THE COURSES OF INSTRUCTION.

[The figures indicate the number of exercises a week; light-faced type, recitation periods of one hour each; heavy-faced type, laboratory periods of two hours each.]

FRESHMAN YEAR.

First Semester.

Language,	English,	3	
	French,	4	
Mathematics,	Algebra,	5	
Science,	Agriculture,	4	
	Botany, 2+1,	3	
Military,	Tactics,	1	
History,		2	
		—	22

Second Semester.

Language,	English,	4	
	French,	4	
Mathematics,	Geometry and trigonometry,	4	
Science,	Anatomy and physiology, half semester, Chemistry, half semester,	4	
	Botany, 1+1,	2	
History,		2	
		—	20

SOPHOMORE YEAR.

First Semester.

Language,	English,	4	
	German,	4	
Physics,		4	
Science,	Agriculture,	4	
	Chemistry,	**3**	
	Zoölogy, 1+1,	2	
		—	21

Second Semester.

Language,	English,	4	
	German,	3	
Physics,		4	
Surveying,		**2**	
Science,	Agriculture, 2+1,	3	
	Chemistry,	**2½**	
	Horticulture,	3	
		—	21½

JUNIOR YEAR.

First Semester.

Course in agriculture,	Agriculture, 3+1,	4	
	Botany, 2+1,	3	
	Chemistry,	3	
	Geology,	3	
	Horticulture,	3	
	English,	4	
		—	20
Course in horticulture,	Horticulture,	4	
	Horticulture, 1+3,	4	
	Botany, 2+1,	3	
	Chemistry,	3	
	Geology,	3	
	English,	4	
		—	21
Course in biology,	Zoölogy, 3+1,	4	
	Botany, 2+1,	3	
	Chemistry,	3	
	Geology,	3	
	Horticulture,	3	
	English,	4	
		—	20
Course in chemistry,	Chemistry,	4	
	Agriculture, 3+1,	4	
	Mathematics,	4	
	Geology,	3	
	English,	4	
	Special subject,	2	
		—	21
Course in mathematics,	Analytical geometry,	4	
	Engineering, 1+3,	4	
	Free-hand drawing,	2	
	Landscape gardening,	4	
	Geology,	3	
	English,	4	
		—	21
Course in landscape gardening,	Landscape gardening,	4	
	Agriculture, 2+1,	3	
	Botany, 2+1,	3	
	Free-hand drawing,	2	
	Horticulture,	3	
	Geology,	3	
	English,	4	
		—	22

Second Semester.

Course in agriculture,	Agriculture, 2+1,	3	
	Botany, 2+1,	3	
	Chemistry,	4	
	Horticulture,	2	
	Entomology,	4	
	Economics,	4	
		—	20
Course in horticulture,	Horticulture,	4	
	Botany, 2+1,	3	
	Chemistry,	4	
	Landscape gardening,	2	
	Entomology,	4	
	Economics,	4	
		—	21
Course in biology,	Entomology,	4	
	Zoölogy,	3	
	Botany, 2+1,	3	
	Chemistry,	4	
	Horticulture,	2	
	Economics,	4	
		—	20
Course in chemistry,	Chemistry,	5	
	Agriculture, 2+1,	3	
	Mathematics,	4	
	Economics,	4	
	Special subject,	5	
		—	21
Course in mathematics,	Engineering,	5	
	Mathematics,	4	
	Mechanical drawing,	2	
	Landscape gardening,	4	
	Economics,	4	
		—	19
Course in landscape gardening,	Landscape gardening,	4	
	Botany, 2+1,	3	
	Mechanical drawing,	2	
	Engineering,	5	
	Entomology,	4	
	Economics,	4	
		—	22

SENIOR YEAR.

First Semester.

The following subjects are required in all courses: —

Bacteriology, half semester, 4, Constitution of the United States, half semester, 4,	4	
Military science,	1	
	—	5

Second Semester.

Constitution of the United States,	4	
Military science,	1	
	—	5

From the following the student must elect three courses, closely correlated with his junior year course; only one course in language may be elected: —

Agriculture,	4	Physics,	4
Horticulture, 3+1,	4	Engineering,	4
Veterinary,	4	English,	4
Botany, 3+1,	4	French,	4
Landscape gardening,	4	German,	4
Entomology, 3+1	4	Spanish,	4
Chemistry, 3+1,	4	Latin,	4

COURSES OF INSTRUCTION FOR SPECIAL STUDENTS.

A TWO-YEARS COURSE FOR WOMEN.

Women are received who wish to pursue the studies named below. No admission examinations are required. There is no charge for tuition. Board may be obtained in the dining hall, and also rooms, so far as the accommodations will permit.

First year, first semester: soils, fertilizers and cultivation, four hours a week; elementary botany, five hours; French, four hours; free-hand drawing, four hours.

Second semester: propagation and pruning (horticulture, one hour), three hours; botany, — morphology, plant analysis, five hours; chemistry, descriptive, five hours; vegetable gardening, four hours; French, four hours.

Second year, first semester: pomology, three hours a week; greenhouse construction and management, three hours; botany, — structure and physiology of plants, five hours; zoölogy, two hours; chemistry, five hours; German, four hours.

Second semester: landscape gardening, three hours a week; floriculture, four hours; vegetable pathology, five hours; entomology, three hours; chemistry, five hours; German, three hours.

SHORT COURSES.

These courses are open to persons of both sexes. Applicants must be at least sixteen years of age, and must furnish papers certifying good moral character. No entrance examination is required. Tuition is free to citizens of the United States. The same privileges in regard to room and board obtain as with other students. Attendance upon chapel is required. The usual fees are charged for apparatus and material used in laboratories. Attendance upon military drill is not expected.

I. DAIRY FARMING.

	Hours per Week.
Soils, tillage and methods of soil improvement; manures and fertilizers and their use; crops and rotations,	4
Breeds and breeding of dairy stock; judging to scale of points,	2
Fodders and feeding farm live stock,	1
Stable construction and sanitation,	1
Common diseases of stock; prevention and treatment,	1
Dairy products: their general characteristics; testing,	2
Chemical composition of milk and of special milk products,	1
Botany,	2
Horticulture,	3
Entomology,	3
Dairy practice, including testing, use of separators, butter making, preparation of certified and modified milk, and pasteurization,	4
Practice in horticulture,	1

Begins first Wednesday in January, and continues ten weeks.

II. HORTICULTURE.

	Hours per Week.
Soils, tillage, manures, etc.,	4
Plant propagation and pruning,	3
General fruit growing,	3
Market gardening,	3
Botany,	4
Entomology,	3
Practice work in seed testing, seeding, grafting, budding, transplanting, judging fruit, etc.	

Begins first Wednesday in January, and continues ten weeks. This course will not be given unless at least eight men register for it.

III. SHORT COURSE IN BEE CULTURE.

	Total Hours.
The structure of bees, with special reference to their work (Prof. H. T. Fernald), ...	3
Flowers and fruits in their relations to bees (Professor Stone), .	10
Honey crops, and how to grow them (Professor Brooks), . .	5
Bees and bee keepers' supplies (Professor Paige), . . .	10
Work in the apiary, under direction of an expert, ...	20
Instruction by specialists, ...	4

This course begins the fourth Wednesday in May, and continues two weeks, but will not be given unless applied for by at least six students.

EQUIPMENT OF THE SEVERAL DEPARTMENTS.

AGRICULTURE.

The part of the college estate assigned to the department of agriculture contains one hundred and sixty acres of improved land, forty acres of pasture and sixteen acres of woodland. The latest inventions in improved agricultural tools and machinery are in practical use. The large and commodious barn and stables are stocked with the best breeds of horses, cattle, sheep and swine. Attached to the barn is a dairy building equipped with the latest machinery, driven by an electric motor. The laboratory is provided with the latest forms of apparatus for mechanical analysis of soils and determination of their physical characteristics. Provision has been made in the laboratory for the study of seeds and crops and for germination trials. Power has been introduced into the laboratory, so that farm machinery may be operated for purposes of demonstration. The department has also a line of instruments for use in drainage and irrigation practicums. The museum contains a collection of implements, seeds, plants and models of animals, all of which are designed to illustrate the evolution and the theory and practice of agriculture. Three large lecture rooms, one in south college and two in the dairy building, and five rooms for laboratory and dairy purposes, have been assigned to this department.

HORTICULTURE.

For illustration of the science and the practice of horticulture the department possesses about one hundred acres devoted to orchards planted with all the leading old and all new varieties of apples, pears, peaches, plums, Japanese and American cherries, quinces, chestnuts, hickory nuts and walnuts; vineyards containing nearly two hundred named varieties of grapes, for sale, beside several hundred seedlings, and about an acre devoted to a commercial crop of a few market varieties; nurseries containing all kinds of fruit and ornamental trees, shrubs and plants, in all stages of growth, from the seed and cuttings to those ready for planting in the orchard or field; small fruit plantations containing valuable varieties, and showing the modern methods of training, pruning and cultivation; extensive greenhouses that contain not only valuable collections of specimen plants, representing types of the flora of the world, but also the most valuable economic plants, such as the orange, banana, lemon, guava, pomegranate, sago palm, arrowroot, tapioca, ginger, pepper, tea, coffee, camphor, India rubber, Manila hemp, banyan tree, etc. All the common greenhouse and outdoor decorative plants are found, and small quantities of roses, carnations, chrysanthemums and other commercial flowering plants are grown, to illustrate the business of horticulture. All vegetable crops, now so largely grown under glass, are grown in limited quantities for purposes of instruction and for market.

For illustration in the work of landscape gardening, the grounds about the greenhouses, as well as that part of the grounds known as the Clark Park, are planted with a very large and complete collection of ornamental trees, shrubs and plants.

For forestry there are two large groves of trees of varying ages, from those of almost primeval growth to the youngest seedlings, besides several plantations of younger growth either natural or planted; and in the Botanical Museum there is a very complete collection of woods of Massachusetts.

All kinds of pumps and other appliances for distributing insecticides and fungicides, as well as various modern tools and implements, are in constant use.

A small cold-storage room makes possible the keeping of the products beyond their natural season, and illustrates one of the most important adjuncts to the business of modern horticulture.

CHEMISTRY.

This department has fourteen rooms, well adapted to their special uses. They are supplied with a large assortment of apparatus and chemical materials. The lecture room on the second floor has a seating capacity for seventy students. Immediately adjoining it are four smaller rooms, used for storing apparatus and preparing materials for the lecture table. The laboratory for beginners is a large room on the first floor, furnished with forty working tables. Each table is provided with reagents and apparatus for independent work. A well-filled laboratory for advanced work is also provided on the first floor. A weighing room has six balances, and improved apparatus for determining densities of solids, liquids and gases. The apparatus includes, besides balances, a microscope, a spectroscope, a polariscope, a photometer, a barometer, and numerous models and sets of apparatus. The various rooms are furnished with an extensive collection of industrial charts. A valuable and growing collection of specimens and samples, fitted to illustrate different subjects taught, is also provided. This includes rocks, minerals, soils, raw and manufactured fertilizers, foods, including milking products, fibres and other vegetable and animal products, and artificial preparations of mineral and organic compounds. Series of preparations are used for illustrating the various stages of different manufactures from raw materials to finished product.

GEOLOGY.

Geological teaching is illustrated by a very complete series of minerals, the State collection of rocks of Massachusetts, a series of Ward's fossils and casts of fossils, models and charts.

ZOÖLOGY.

Sophomore Laboratory. — A large, well-lighted room, situated in the old chapel building, is fitted with tables and apparatus, such as microscopes, dissecting instruments and the like, which are necessary for a beginners' course in zoölogical dissection.

Advanced Laboratory. — The room formerly used as a lecture room has been fitted up as a laboratory for advanced students. It is in South College, adjacent to the museum, and is amply supplied with the best apparatus obtainable. The equipment includes compound and simple microscopes, dissecting instruments and trays, an incubator, paraffin bath, microtomes, etc., also a reference library, containing the current zoölogical journals and a good series of mounted slides for the microscope.

Zoölogical Lecture Room. — The department has the privilege of using the philosophical lecture room, which communicates directly with the advanced laboratory. The lecture equipment includes, besides the museum specimens, the Leuckart series of charts, and many specially made charts as well; the Auzoux models, illustrative of human and comparative anatomy; and an electric stereopticon.

Museum of Zoölogy. — The museum is mainly for the purpose of exhibiting those forms treated of in the lecture and laboratory courses, but, in addition to this, the aim has been to show as fully as possible the fauna of the Commonwealth, and those types which show the evolution and the relationship of the members of the animal kingdom. The total number of specimens contained in the museum now exceeds eleven thousand. The museum is open to the public from 3.30 to 5.30 P.M. each week day.

Entomological Laboratory. — The equipment for work in entomology during the senior year and for graduate students is unusually good. The laboratory building contains a large room for laboratory work, provided with tables, dissecting and compound microscopes, microtomes, reagents and glass ware. One portion of the building is fitted up as a lecture room. Another room is devoted to library purposes, and contains a card catalogue of over fifty thousand cards, devoted to the literature of insects. In addition to a well-selected list of entomological works in this room, the college library has an unusual number of rare and valuable books on this subject. This is supplemented by the private entomological library of the professor in charge, which contains over twenty-five hundred volumes, many of which cannot be found elsewhere in the United States. In another room is a large and growing collection of insects, both adult and in the early stages, which is of much assistance to the students. As the laboratory is directly connected with the insectary of the Hatch Experiment Station, the facilities of the latter are directly available. The apparatus room of the insectary, with its samples of spray pumps, nozzles and other articles for the practical treatment of insects; the chemical room fitted up for the analysis of insecticides and other chemico-entomological work; and a greenhouse, where plants infested by injurious insects are under continual observation and experimental treatment, — all these are available to the student. In addition, several private laboratory rooms and a photographing room with an unusually good equipment of cameras are provided. The large greenhouses, grounds, gardens and orchards of the college are also to be mentioned under this head, providing, as they do, a wide range of subjects for study of the attacks of injurious insects under natural conditions.

VETERINARY SCIENCE.

The department has for its sole use a commodious and modern laboratory and hospital stable, erected in 1899. Both buildings are constructed according to the latest ideas as regards sanitation. Every precaution has been taken in the arrangement of details to prevent the spread of disease, and to provide for effective heating, lighting, ventilation and disinfection.

The laboratory building contains a large working laboratory for student use, and several small private laboratories for special work. In addition, there is a lecture hall, museum, demonstration room, photographing room and work shop. The hospital stable contains a pharmacy, operating hall, post-mortem and disinfecting room, besides a section for poultry, one for cats and dogs, and six sections, separated from each other, for the accommodation of horses, cattle, sheep, swine and other domestic animals.

The laboratory equipment consists of a dissecting Auzoux model of the horse, Auzoux models of the foot and the legs, showing the anatomy and the diseases of every part. There are skeletons of the horse, cow, sheep, dog and pig, and, in addition, a growing collection of anatomical and pathological specimens. The lecture room is provided with numerous maps, charts and diagrams, which are made use of in connection with lectures and demonstrations.

The laboratories are supplied with the most modern high-power microscopes, microtomes, incubators and sterilizers, for the use of students taking the work in bacteriology and parasitology.

BOTANY.

The botanical department possesses a general laboratory, furnished with tables and benches for microscopical and physiological work, and with a dark closet for photographic purposes. There are forty compound microscopes, twenty-three dissecting microscopes, a micro-photographic and landscape camera and various accessories; also microtomes, paraffin baths, etc., for histological work; a large and useful collection of physiological apparatus for the study of photo-synthesis, respiration, metabolism, transpiration, heliotropism, geotropism, hydrotropism, galvanotropism, chemotropism, and other irritable phenomena connected with plants; a set of apparatus for the study of the mechanical constituents of the soil, and for experimental work in soil physics; a large and unique outfit of electrical appliances for the study of all phenomena related to electricity and plant growing; various devices for the study of mechanics of plant structure; numerous contrivances to determine the power exerted by living plant organisms; several types of self-registering auxanometers, used to measure the rate of growth of plants; self-registering thermometers, and hygrometers for recording constant changes in conditions.

A small special laboratory for graduate students is equipped with microscopes and other apparatus and reagents for advanced work.

Botanical Lecture Room. — The botanical lecture room adjoining the laboratory is adapted for general work in morphology and flower analysis, with opportunity to use dissecting microscopes. It contains a movable chart system, arranged to display over three thousand figures relating to the structure and function of plants.

MATHEMATICS, PHYSICS AND ENGINEERING.

Surveying. — The department possesses a considerable number of the usual surveying instruments, with the use of which the students are required to become familiar by performing a required amount of field work. Among the larger instruments are two plain compasses, railroad compass with telescope, surveyor's transit, two engineer's transits with vertical arc and level, solar compass, omnimeter with verniers reading to ten seconds, adapted to geodetic work, Queen plane table, two wye levels, dumpy level, builder's level, sextant, hand level, and a large assortment of levelling rods, flag poles, chains, tapes, etc. For draughting, a vernier protractor, pantograph, parallel rule, etc., are available.

Physics. — Among the apparatus in use for general instruction in general physical processes may be found a set of United States standard weights and measures, precision balances, spherometer, vernier calipers, etc.; in mechanics, apparatus to illustrate the laws of falling bodies, systems of pulleys and levers, motion on an incline plane, and the phenomena connected with the mechanics of liquids and gases. The usual apparatus for lecture illustration in heat, light and sound are also in the possession of the department. In electricity, the equipment consists of apparatus for both lecture illustration and laboratory work, among which may be enumerated a full set of Weston ammeters and volt meters, a Carhart-Clark standard cell, Mascart quadrant electrometer, Siemens electrodynamometer, as well as reflecting galvanometers and Wheatsone bridges for ordinary determinations of currents and resistance.

MILITARY SCIENCE.

In addition to a large campus, suitable for battalion drill, the military department possesses a special building in which there is a drill room 60 by 135 feet, an armory, a recitation room, an office for the commandant, and a field gun and gallery practice room. The building also has a large bathroom immediately adjoining the armory.

In a plot of ground north of the college building there is a rifle range, marked for practice at distances of 100 and 200 yards. The range is furnished with a revolving target suitably protected by earthworks. The national government supplies, for the use of the department, arms and equipments; the Springfield cadet rifle and two breech-loading rifled steel guns, calibre 3.2, with complete equipments and ammunition.

The State supplies instruments for the college band.

Students are held responsible for all articles of public property while in their possession.

THE CHAPEL-LIBRARY BUILDING.

One of the most attractive and commodious buildings belonging to the college is the chapel-library. It has a commanding position, approximately in the centre of the group of buildings adjoining the campus. The chapel occupies the entire second story. A large room, capable of seating about four hundred, is used for daily prayers, Sunday services, the various commencement exercises, and not infrequently for lectures or social gatherings. The room has an excellent pipe organ. Two adjoining rooms are used for small religious gatherings, and meetings of the class teachers and of the faculty. The rooms can be thrown open so as to become a part of the main audience hall.

The entire lower story is given over to the library. This library is available for reference or investigation, and is open daily, except on Sundays, from 8 A.M. to 5 P.M. and from 6.30 to 8.30 P.M. It is open on Sundays from 10 A.M. to 1 P.M. The volumes at present number 25,829. The library contains carefully selected books in the departments of agriculture, horticulture, botany, entomology and other natural sciences. Sociology, economics, history, literature, the fine arts and the useful arts are well represented. Constant additions will be made to secure the latest and best works in the several departments of learning.

DINING HALL.

A colonial dining hall, built of brick and equipped with all modern conveniences, was completed and opened February, 1903, for the accommodation of students. A committee composed of two members of the faculty, two members of the student body, and the steward, manages the affairs of the dining hall.

The hall contains a number of suites of rooms which may be secured for occupancy by young women attending any of the departments of the college.

THE HEATING, LIGHTING AND POWER PLANT.

This plant is located in the ravine, near the chemical laboratory. It is equipped with two large boilers, an engine and an electric generator. Here steam is generated which heats the college buildings on the west side of the public highway, extending from the dining hall to the veterinary laboratory. Here also is produced the electricity which lights all the buildings and the grounds of the college. Electric power is also generated which is used to drive the machinery in the dairy and in the barn. Connected with the plant is a machine shop in which much work is done for the college. The plant affords opportunity for students in mechanical and electrical engineering to observe the modern utilization of steam and electricity.

EXPENSES.

Tuition. — Tuition is free to citizens of the United States. Citizens of Massachusetts, however, in accordance with an act of the Legislature, must make application to the Senator of the district in which they live for a free scholarship that covers the charge for tuition. Blank forms for such application may be obtained from the president of the college.

Rooms. — It is expected that students will occupy rooms in the college dormitories, unless excused to room elsewhere. For the information of those desiring to carpet their rooms, the following measurements are given: in the south dormitory the study rooms are about fifteen by fourteen feet, with a recess seven feet four inches by three feet; and the bedrooms are eleven feet two inches by eight feet five inches. In the north dormitory the corner rooms are fourteen by fifteen feet, and the annexed bedrooms eight by ten feet. The inside rooms are thirteen and one-half by fourteen and one-half feet, and the bedrooms eight by eight feet. All rooms are unfurnished. Mr. Thomas Canavan has the general superintendence of the dormitories, and all correspondence relative to the engaging of rooms should be with him.

Board. — Board at the new dining hall has been $3.25 per week; in private families, $4 to $5.

Incidental Expenses. — The military suit must be obtained immediately upon entering college, and used in the drill exercises prescribed. The following fees, to be paid in advance, are applied towards the maintenance of the several laboratories: chemical, $15 per semester used; zoölogical, $2 per semester used sophomore year, other classes $4 per semester; entomological, $3 per semester used. The fee for use of the botanical laboratory for one period of two hours during each week is $1 per semester; other periods will be charged for proportionally. Some expense is also incurred for text-books. In exceptional cases incidental expenses necessitate additional charges.

Room rent, in advance,	$15 00	$45 00
Board, $3.25 to $4 per week,	117 00	144 00
Fuel,	12 00	12 00
Washing, 30 to 60 cents a week,	11 00	22 00
Military suit,	12 50	20 00
Lights,	12 00	12 00
Miscellaneous,	41 00	45 00
	$220 50	$300 00

In addition to the above expenses, $120 tuition is charged to foreigners.

SCHOLARSHIPS.

Established by Private Individuals.

Mary Robinson Fund of one thousand dollars, the bequest of Miss Mary Robinson of Medfield.

Whiting Street Fund of one thousand dollars, the bequest of Whiting Street, Esq., of Northampton.

Henry Gassett Fund of one thousand dollars, the bequest of Henry Gassett, Esq., of North Weymouth.

The income of the above funds is assigned by the faculty to worthy students requiring aid.

CONGRESSIONAL SCHOLARSHIPS.

The trustees voted in January, 1878, to establish one free scholarship for each of the congressional districts of the State. Application for such scholarships should be made to the representative from the district to which the applicant belongs. The selection for these scholarships will be determined as each member of Congress may prefer; but, where several applications are sent in from the same district, a competitive examination would seem to be desirable. Applicants should be good scholars, of vigorous constitution, and should enter college with the intention of remaining through the course.

STATE SCHOLARSHIPS.

The Legislature of 1883 passed the following resolve in favor of the Massachusetts Agricultural College: —

> *Resolved*, That there shall be paid annually, for the term of four years, from the treasury of the Commonwealth to the treasurer of the Massachusetts Agricultural College, the sum of ten thousand dollars, to enable the trustees of said college to provide for the students of said institution the theoretical and practical education required by its charter and the law of the United States relating thereto.
>
> *Resolved*, That annually for the term of four years eighty free scholarships be and hereby are established at the Massachusetts Agricultural College, the same to be given by appointment to persons in this Commonwealth, after a competitive examination, under rules prescribed by the president of the college, at such time and place as the senator then in office from each district shall designate; and the said scholarships shall be assigned equally to each senatorial district. But, if there shall be less than two successful applicants for scholarships from any senatorial district, such scholarships may be distributed by the president of the college equally among the other districts, as nearly as possible; but no applicant shall be entitled to a scholarship unless he shall pass an examination in accordance with the rules to be established as hereinbefore provided.

The Legislature of 1886 passed the following resolve, making perpetual the scholarships established: —

> *Resolved*, That annually the scholarships established by chapter forty-six of the resolves of the year eighteen hundred and eighty-three be given and continued in accordance with the provisions of said chapter.

In accordance with these resolves, any one desiring admission to the college can apply to the senator from his district for a scholarship. Blank forms of application will be furnished by the president.

THE LABOR FUND.

The object of this fund is to assist those students who are dependent either wholly or in part on their own exertions, by furnishing them work in the several departments of the college. The greatest opportunity for such work is found in the agricultural and horticultural departments. Application should be made to Profs. William P. Brooks and Frank A. Waugh, respectively in charge of said departments. Students desiring to avail themselves of its benefits must bring a certificate signed by one of the selectmen of the town in which they are resident, certifying to the fact that they require aid.

PRIZES.

Burnham Rhetorical Prizes.

These prizes are awarded for excellence in declamation, and are open to competition, under certain restrictions, to members of the sophomore and freshman classes.

Flint Prizes.

Mr. Charles L. Flint of the class of 1881 established two prizes, one of thirty dollars and another of twenty dollars, to be awarded, at an appointed time during commencement week, to the two members of the junior class who may produce the best orations. Excellence in both composition and delivery is considered in making the award.

Notwithstanding the death of Mr. Flint, in June, these prizes will be continued under the name of the Flint prizes.

Grinnell Agricultural Prizes.

Hon. William Claflin of Boston has given the sum of one thousand dollars for the endowment of a first and second prize, to be called the Grinnell agricultural prizes, in honor of George B. Grinnell, Esq., of New York. These two prizes are to be paid in cash to those two members of the graduating class who may pass the best written and oral examination in theoretical and practical agriculture.

Hills Botanical Prizes.

The Hills prizes of thirty-five dollars, given by the late Henry F. Hills of Amherst, will this year be awarded to members of the senior class as follows: fifteen dollars for the best general herbarium; ten dollars for the best collection of Massachusetts trees and shrubs; and ten dollars for the best collection of Massachusetts woods.

WINTER COURSE PRIZES.

The dairy prizes, given by the Massachusetts Society for Promoting Agriculture, to members of the short winter course. Two sets of prizes are offered: the first set consists of three prizes of fifty, thirty and twenty dollars, respectively, given for general excellence in all branches of the course as offered; the second set consists of three prizes of twenty-five, fifteen and ten dollars, respectively, for excellence in the making of butter.

AWARD OF PRIZES, 1904.

Grinnell Agricultural Prizes (*Senior*). — First prize, Arthur Witter Gilbert; second prize, Sidney Burritt Haskell.

Hills Botanical Prizes (*Senior*). — First and second prizes, Ernest Adna Back.

Flint Oratorical Prizes (*Junior*). — First prize, George Howard Allen; second prize, Albert Davis Taylor.

Burnham Essay Prizes (*Sophomore*). — First prize, Arthur Alphonse Racicot, Jr.; second prize, Edwin Hobart Scott; third prize, Frank Augustus Ferren.

Burnham Declamation Prizes (*Freshman*). — First prize, Charles Arthur Allenham Rice; second prize, George Whitney Searle.

Military Honors (*Senior*). — The following cadets were reported to the Adjutant-General, U. S. A., and to the Adjutant-General of Massachusetts, as having shown special aptitude for military service: Fayette D. Couden, Howard M. White, Clarence H. Griffin.

Winter Course in Dairy Farming. — Massachusetts Society for Promoting Agriculture: for general excellence, first prize, $50, Charles H. Thayer; second prize, $30, Gordon Runkle; third prize, $20, Fred S. Farwell.

Massachusetts Society for Promoting Agriculture: for highest scoring tub butter, first prize, $25, Chester D. Abbott; second prize, $15, Albert W. Mead; third prize, $10, Alvah G. Eldridge.

Massachusetts Society for Promoting Agriculture: for excellence in stock judging, first prize, $10, Fred M. Pick; second prize, $7.50, Gordon Runkle; third prize, $5, Homer G. Phillips; fourth prize, $2.50, Chester L. Shaw.

The Vermont Farm Machine Company of Bellows Falls, Vt.:

for highest scoring print butter, first prize, $15; Albert W. Mead; second prize, $10, Alvah G. Eldridge.

Special prize, offered by W. H. Bowker of Boston, for best knowledge of the use of fertilizers on the farm, one-half ton Stockbridge fertilizer, Gordon Runkle.

Special prize, given by B. von Herff of New York, for best knowledge of the use of fertilizers on grass lands, one ton kainite, Gordon Runkle.

RELIGIOUS SERVICES.

Chapel services are held every week day at 8 A.M. Further opportunities for moral and religious culture are afforded by Bible classes taught by one of the professors and other teachers for an hour every Sunday afternoon, and by a religious meeting Thursday evening under the auspices of the College Young Men's Christian Association.

LOCATION.

Amherst is on the New London Northern Railroad, connecting at Palmer with the Boston & Albany Railroad, and at Millers Falls with the Fitchburg Railroad. It is also on the Central Massachusetts Railroad, connecting at Northampton with the Connecticut River Railroad and with the New Haven & Northampton Railroad.

The college buildings are on a healthful site, commanding one of the finest views in New England. The large farm of four hundred acres, with its varied surface and native forests, gives the student the freedom and quiet of a country home.

REPORTS.

TREASURER'S REPORT.

RECEIPTS AND EXPENDITURES FOR YEAR, JAN. 1 TO DEC. 21, 1904.

RECEIPTS.

State Treasurer, Morrill fund, . . .		$16,666 66	
Endowment fund, ...		10,127 12	
Maintenance appropriation, . . .		5,000 00	
Instruction appropriation, . . .		11,750 00	
Scholarship appropriation, . . .		13,750 00	
Labor appropriation, ...		5,000 00	
Special for deficit in coal in 1903, . .		3,500 00	
Heating and lighting maintenance, .		375 00	
Dining-hall maintenance, . . .		375 00	
Labor fund, ...		19 29	
Library fund, ...		641 10	
Burnham emergency fund, ...		150 00	
Botanical laboratory, ...		117 00	
Chemical laboratory, ...		652 14	
Entomological laboratory, ...		58 23	
Veterinary laboratory, appropriation, ...	$500 00		
Cash, ...	15 75		
		515 75	
Zoölogical laboratory, ...		102 50	
Landscape gardening tax, ...		54 50	
Term bill, ...		4,065 49	
Heating and lighting, ...		2,060 72	
Agricultural department, ...		875 45	
Farm, ...		6,730 12	
Horticultural department, ...		4,881 12	
Expense, ...		880 68	
Tools and implements, ...		1 01	
Furniture, ...		3 00	
			$88,351 88

EXPENDITURES.

Labor fund, ...	$4,955 97
Library, ...	3,108 08
Botanical laboratory, ...	137 74
Chemical laboratory, ...	185 63
Amount carried forward, . . .	$8,387 42

Amount brought forward,	$8,387 42	
Entomological laboratory,	111 49	
Veterinary laboratory,	1,156 93	
Zoölogical laboratory,	284 61	
Landscape gardening,	28 90	
Burnham emergency fund,	125 00	
Salary,	30,910 48	
Extra instruction,	185 00	
Term bill,	1,372 89	
Advertising,	450 20	
Heating and lighting,	8,080 22	
Agricultural department,	1,913 68	
Farm,	10,561 45	
Horticultural department,	8,487 44	
Expense,	8,850 26	
Insurance,	15 00	
Tools and implements,	7 75	
Furniture,	235 97	
Dining hall, 1903,	3,774 16	
Dining hall, 1904,	3,669 52	
Total expenditures,		$88,608 37
Total receipts,		88,351 88
Excess of expenditures over receipts,		$256 49

CASH ACCOUNT.

Dr.

Cash on hand Jan. 1, 1904,		$6,754 70

Cr.

Cash on hand and in local bank Dec. 21, 1904,	$4,698 21	
Deposit with Hampden Trust Company,	1,800 00	
Excess of expenditures over receipts,	256 49	
		$6,754 70

INVENTORY — REAL ESTATE.

Land (Estimated Value).

College farm,	$37,000 00	
Pelham quarry,	500 00	
Bangs place,	2,350 00	
Clark place,	4,500 00	
		$44,350 00

Buildings (Estimated Value).

Drill hall,	$5,000 00	
Powder house,	75 00	
Gun shed,	1,500 00	
Amounts carried forward,	$6,575 00	$44,350 00

Amounts brought forward,	$6,575 00	$44,350 00
Stone chapel,	30,000 00	
South dormitory,	35,000 00	
North dormitory,	25,000 00	
Chemical laboratory,	8,000 00	
Entomological laboratory,	3,000 00	
Veterinary laboratory and stable,	22,500 00	
Farmhouse,	2,000 00	
Horse barn,	5,000 00	
Farm barn and dairy school,	33,000 00	
Graves house and barn,	1,500 00	
Boarding house,	1,000 00	
Dining hall,	35,000 00	
Botanic museum,	5,500 00	
Botanic barn,	2,500 00	
Tool house,	2,000 00	
Durfee plant house and fixtures,	13,000 00	
Small plant house, with vegetable cellar and cold grapery,	4,700 00	
President's house,	6,500 00	
Dwelling houses purchased with farm,	5,000 00	
		246,775 00
		$291,125 00

EQUIPMENT.

Botanical department,	$4,310 00	
Horticultural department,	14,113 89	
Farm,	17,912 58	
Chemical laboratory,	1,775 00	
Botanical laboratory,	2,866 53	
Entomological laboratory,	15,425 00	
Zoölogical laboratory,	3,286 00	
Zoölogical museum,	6,103 00	
Veterinary laboratory,	6,004 46	
Physics and mathematics,	3,848 60	
Agricultural department,	3,500 00	
Agricultural laboratory,	1,300 00	
Library,	25,973 00	
Fire apparatus,	400 00	
Band,	350 00	
Furniture,	1,400 00	
Text-books,	300 00	
Tools, lumber and supplies,	252 00	
Heating and lighting,	53,423 00	
Dining hall,	5,000 00	
		$167,543 06

Balance Sheet Dec. 21, 1904.

Assets.

Real estate,		$291,125 00	
Equipment,		167,543 06	
			$458,668 06

Quick Assets.

Bills receivable: —			
Farm,	$245 84		
Horticulture,	497 93		
Heating and lighting,	846 06		
Rents and text-books,	813 15		
Laboratory fees,	478 00		
Dining hall,	534 50		
Mary Robinson fund,	36 76		
Whiting Street fund,	5 24		
		$3,457 48	
Notes,		72 00	
Cash on hand and in local bank,		4,698 21	
Hampden Trust Company,		1,800 00	
			10,027 69
			$468,695 75

Liabilities.

Bills payable: —			
Farm,	$1,401 54		
Horticulture,	392 66		
Expense,	74 09		
Heating and lighting,	846 65		
Library,	221 25		
Furniture,	49 75		
Laboratories,	17 11		
Due Gassett scholarship,	22 00		
Due Grinnell prize,	66 24		
Due Hills fund,	462 43		
Due Burnham emergency,	135 56		
Due labor fund,	371 01		
Due individual labor,	349 72		
Due veterinary laboratory,	154 82		
		$4,564 83	
Burnham emergency fund,		3,000 00	
			7,564 83
Balance,			$461,130 92

INVESTMENT.

Endowment Fund.

United States grant, ...	$219,000 00	
Commonwealth grant, ...	142,000 00	
		$361,000 00

This fund is in the hands of the State Treasurer, and the Agricultural College receives two-thirds of the income from the same (for amount of income, see college receipts).

Individual Labor Fund.

Two bonds American Telephone and Telegraph 4s, ...	$2,000 00	
One bond New York Central debenture 4s,	1,000 00	
Hampden Trust Company, ...	1,500 00	
Cash, ...	500 00	
		$5,000 00

Hills Fund.

Northampton Institution for Savings, . .	$2,180 00	
One bond American Telephone and Telegraph 4s, ...	1,000 00	
Three American Telephone notes, 5 per cent.,	3,000 00	
One bond New York Central debenture 4s,	1,000 00	
One bond New York Central & Lake Shore 3½s, ...	1,000 00	
Boston & Albany Railroad stock, . . .	362 00	
		$8,542 00

Burnham Emergency Fund.

Northampton Institution for Savings, . .	$2,000 00	
Massachusetts Agricultural College note, .	3,000 00	
		$5,000 00

(For amount of income, see college receipts.)

Mary Robinson Fund.

Northampton Institution for Savings, . .	$820 00	
Boston & Albany Railroad stock, . . .	38 00	
		$858 00

Whiting Street Fund.

One bond New York Central debenture 4s,	$1,000 00	
Amherst Savings Bank, ...	260 00	
		$1,260 00

Gassett Scholarship Fund.

One bond New York Central debenture 4s, ...		$1,000 00

Grinnell Prize Fund.

Ten shares New York Central & Hudson River Railroad stock,	$1,000 00

Massachusetts Agricultural College.

One share New York Central & Hudson River Railroad stock,	$100 00

Library Fund.

Amherst Savings Bank,	$10,546 12

(For amount of income, see college receipts.)

INVESTMENT CASH ACCOUNT.

FUND.

Receipts.

Hampden Trust Company, individual labor fund,		$3,000 00	
Northampton Institution for Savings, Hills fund,	$4,000 00		
Agawam National Bank, Hills fund,	2,000 00		
		6,000 00	
Amherst Savings Bank, Whiting Street fund,		1,000 00	
Amherst Savings Bank, Gassett scholarship fund,		1,000 00	
Coupons American Telephone notes, (Toward payment in premium of same.)		75 00	
Cash, individual labor fund,		500 00	
			$11,575 00

Expenditures.

Two bonds, individual labor fund,	$1.859 00	
One bond, individual labor fund,	997 61	
One bond, Hills fund,	969 67	
Two notes, Hills fund,	3,113 75	
One bond, Hills fund,	1,010 08	
One bond, Hills fund,	908 75	
One bond, Whiting Street fund,	988 36	
One bond, Gassett scholarship fund,	988 36	
		10,835 58
Excess of receipts over expenditures,		$739 42

INCOME.

Receipts.

Individual labor fund,	$103 80	
Hills fund,	363 43	
Mary Robinson fund,	34 07	
Whiting Street fund,	45 20	
Gassett scholarship fund,	40 00	
Grinnell prize,	50 00	
Massachusetts Agricultural College,	5 00	
		$641 50

Expenditures.

Individual labor fund,	$16 25	
Hills fund,	106 16	
Mary Robinson fund,	91 20	
Whiting Street fund,	71 64	
Gassett scholarship fund,	66 16	
Grinnell prize,	55 00	
		406 41
Excess of receipts over expenditures,		$235 09

This is to certify that I have examined the accounts of George F. Mills, treasurer of Massachusetts Agricultural College, for the year ending Dec. 21, 1904. All bonds and investments are as represented in the report. All disbursements are properly vouched for, and all cash balances are found to be correct.

CHARLES A. GLEASON,
Auditor.

AMHERST, Dec. 23, 1904.

GIFTS.

From W. H. Bowker (M. A. C., '71), Boston, one-half ton high-grade Stockbridge fertilizer, for prize in dairy school.

Massachusetts Society for Promoting Agriculture, Boston, one hundred and seventy-five dollars in prizes for dairy school.

B. von Herff, New York, one ton kainite, for prize in dairy school.

Vermont Farm Machine Company, Bellows Falls, Vt., twenty-five dollars in prizes for dairy school.

National Milk Sugar Company, New York, four hundred pounds milk albumen.

Chilean Nitrate Works, New York, four thousand pounds nitrate of soda.

S. M. Barnard Company, Forestville, Conn., two stanchions.

Cyphers Incubator Company, Buffalo, N. Y., one gallon napcreol.

Stoddard Manufacturing Company, Rutland, Vt., one gallon turbine separator oil.

Mt. Tom Sulphite Pulp Company, Mt. Tom, seventy pounds wood pulp.

J. A. Bennett & Son, Gouverneur, N. Y., one incubator, one brooder.

Joseph Breck & Sons, Boston, one incubator, one brooder.

M. Campbell Fanning Mill Company, Detroit, Mich., one incubator, one brooder.

John R. Clisby, Arcola, Ill., eight ears seed corn.

Edmund Mortimer & Co., New York, one ton Peruvian guano.

Chemical Works, late H. & E. Albert, London, Eng., two tons basic slag.

Wesson Stanchion Company, Cuba, N. Y., two stanchions.

W. T. Snow, Westfield, fifty pounds bone charcoal.

Seed Laboratory, United States Department of Agriculture, Washington, D. C., two sets of seeds in vials.

From GERMAN KALI WORKS, New York, thirty-five hundred pounds potash-magnesia sulfate; twenty-five hundred pounds high-grade sulfate; five thousand pounds muriate; one hundred pounds silicate; two hundred and twenty-four pounds carbonate; five hundred pounds kainite.

PETER HENDERSON & Co., New York, twenty-six varieties of grass seed, seven of clover, seven of oats, four of barley, one of rye.

D. H. BURRILL & Co., Little Falls, N. Y., paint, varnish and transfers for eight testers.

C. S. PLUMB (M. A. C., '82), Columbus, O., herbarium containing one thousand species native American plants.

WALLACE R. PIERSON (M. A. C., '91), Cromwell, Conn., one hundred and sixty rose plants.

Mrs. ANNIE TRUMBULL SLOSSON, New York, collection of Florida Hemiptera.

R. A. COOLEY (M. A. C., '95), Bozeman, Montana, J. R. DE LA TORRE BUENO, New York, and others, insects.

Mrs. CHARLES L. FLINT, Brookline, collection of zoölogical specimens, minerals and curios.

ESTHER C. CUSHMAN (M. A. C., '05), Amherst, partridge.

HAROLD E. HODGKISS (M. A. C., '02), Wilkinsonville, horned toad.

LOANS.

From EMPIRE CREAM SEPARATOR COMPANY, Bloomfield, N. J., two separators.

P. M. SHARPLES, West Chester, Pa., three separators.

NATIONAL DAIRY MACHINE COMPANY, Newark, N. J., one separator and stand.

VERMONT FARM MACHINE COMPANY, Bellows Falls, Vt., five separators, one tester.

DE LAVAL SEPARATOR COMPANY, New York, six separators.

DES MOINES INCUBATOR COMPANY, Des Moines, Ia., one incubator, one brooder.

HUMPHREY & SONS, Joliet, Ill., one brooder.

STODDARD MANUFACTURING COMPANY, Rutland, Vt., combined churn and butter-worker, pasteurizer.

FARM REPORT.

During the past year a change has been made in the management of the college farm. Mr. E. A. Jones, who had faithfully discharged the duties of farm superintendent for ten years, sent in his resignation in March, to take effect on the first of May. His place was taken on this date by E. H. Forristall, M.S., of the New Hampshire Agricultural College, who at one time successfully superintended the college farm of that institution, and later accepted and filled the position of superintendent on one of the farms managed for the production of high-grade milk by the Walker-Gordon Company. Mr. Forristall has taken hold of the work of his position with much enthusiasm. It would be manifestly unfair to judge his work on the basis of the results obtained during the past season, for he had not the advantage of beginning as early as would have been desirable, and the season, like those of the two previous years, has been highly unfavorable to success with some of our most important crops. The excessive rainfall during the period from about the 1st of April to the 7th of June, and the abnormally low summer temperatures, are conditions responsible for the partial failure of all crops requiring a long and warm season. The effects of the seasonal peculiarities referred to were greatly aggravated by the fact that the first killing frost came fully three weeks earlier than is usual in this section (September 22). The corn crop, which, on account of the excessive wetness of many of our fields, was not all planted until after the middle of June, was seriously injured by this early freeze. The crops of the year which have given best returns are hay, roots and celery. All of these gave results better than average, both as regards quantity and quality. The nature of the farm operations and the financial results with the several crops are shown in the following table: —

College Farm Crops.

CROPS.	Acres.	TOTAL PRODUCT.		COST.		Value.	Net Profit.	Loss.
		Bushels.	Tons.	Manure.	Labor and Seed.			
Celery,	1	170 doz. bunches.	-	$10 47	$53 45	$229 50	$154 58	-
Carrots,	⅓	251	-	11 23	15 00	125 50	99 27	-
Mangels,	⅓	-	23⅓	11 23	15 90	116 66	89 53	-
Turnips,	-	138	-	-	28 10	34 50	6 40	-
Ensilage corn,	22	-	300	288 70	443 90	1,050 00	317 40	-
Field corn,	8	465 hard. 75 soft.	Stover 22	121 50	259 40	585 60	204 50	-
Potatoes,	8	725 large. 300 small.	-	159 50	443 90	451 01	-	$152 39
Hay,	71	-	190	-	482 55	2,376 00	-	-
Rowen,	-	-	60	-		960 00	-	-
Rowen pastured,	-	-	10	-		50 00	-	-
Oats and peas, green,	1	-	15	-	31 00	45 00	-	-

THE SYSTEM FOLLOWED IN THE USE OF MANURES AND FERTILIZERS.

The manures and fertilizers used for the several crops of the year are shown in the table on the following page. It is our practice to haul manure from the pits in which it accumulates at frequent intervals, and, as a rule, it is spread when hauled. Much of the manure used accordingly lies upon the surface several months. On old land it is plowed under in spring. If applied to sod land, which has been fall plowed, the manure is worked into the ground with a disc harrow in spring. The fertilizers used for the several hoed crops are for the most part spread broadcast after the field is plowed, and harrowed in, although it is our practice to use a moderate amount of nitrate of soda together with a little acid phosphate and potash in the drill. The potato crop is in some respects an exception. We find that with this better results are obtained if a larger proportion of the fertilizer is applied in the drill; and, as a rule, about two-thirds of the total amount is so applied. The fertilizers used on grass lands are applied in mid-spring by the use of the Stevens broadcast fertilizer distributer.

Manures and Fertilizers for the Several Crops per Acre.

	Corn, Campus, Two Acres.	Corn, Eight Acres.	Corn, Ensilage, Twelve Acres.	Field Corn.	Mangels, One-third Acre.	Carrots, One-third Acre.	Potatoes, Eight Acres.
Manure (cords),	-	3	3	2	4	4	4
Nitrate of soda (pounds),	100	100	125	125	200	200	100
High-grade sulfate of potash (pounds),	150	125	150	150	-	-	250
Phosphatic slag (pounds),	500	300	500	500	600	600	-
Lime (pounds),	-	-	-	2,000	-	-	-
Muriate of potash (pounds),	-	-	-	-	350	350	-
Dried blood (pounds),	-	-	-	-	-	-	150
Tankage (pounds),	-	-	-	-	-	-	250

EXPERIMENTS IN THE USE OF MANURES AND FERTILIZERS.

A. Method of Application of Barnyard Manure.

On the grounds of the experiment station we have for a number of years been comparing two systems of handling manures; namely, spreading the fresh manure upon the surface of the ground during the late fall and winter months, in comparison with the system of putting the fresh manure as made during the winter into large heaps, from which it is taken in the spring when the land is ready to plow. The manure in both cases is plowed in, but that spread in winter lies on the surface a variable time, from an extreme period of five months to a few weeks only. The field in the experiment station grounds where these two systems are under comparison is one with a considerable slope. It seemed desirable to compare these same methods upon level land, and a field suited to that purpose was found on the grounds of the college farm. Two plots of one acre each were laid out in the autumn of 1901. The crops of the two following seasons were corn, and for both years the yield of corn on the winter-spread manure was slightly greater than on that spread in the spring. The crop during the past season also was corn for the silo. The yield on the acre on which the manure was spread in winter was 43,855 pounds: on the acre on which it was spread in the spring, 27,240 pounds. The advantage appears to be largely in favor of winter spreading; but, although it is impossible to point to any accidental variation in conditions on the two plots, it seems difficult to believe that the difference in the time of spreading the manure should be responsible for so great a difference in the crops.

B. Experiment in the Use of Fertilizers on Permanent Mowings.

On different portions of the college campus, which is kept permanently in grass, we have laid out a considerable number of plots to which various combinations and amounts of fertilizers have been applied. Nitrate of soda is used alone on a few plots, a potash salt and basic slag on a number of others, a potash salt and basic slag and varying quantities of nitrate of soda on still others. The continuous use of nitrate of soda alone has produced a fair crop of hay, which consists exclusively of grasses. In a half-acre plot, to which nitrate of soda alone has been applied since 1899, there is at present scarcely a single clover plant. On an adjoining plot, with soil of precisely the same character, to which at first potash alone was applied, and to which for the past two years muriate of potash and basic slag have been applied, clovers predominate. On those plots to which a potash salt and basic slag together with nitrate of soda is applied, there is a considerable proportion of clover, and the crops have been very satisfactory. During the past season the usual rate of application has been: muriate or high-grade sulfate of potash, 150 pounds; basic slag, 500 pounds, per acre; and with these amounts of potash and slag we have used nitrate of soda on different plots in quantities ranging from 150 to 250 pounds per acre. The larger applications of nitrate in general gave most profitable crops, although in one of our fields extensive lodging was the consequence whenever nitrate was applied in quantities in excess of 200 pounds to the acre.

LIVE STOCK.

The general average of health maintained by our live stock during the past year has been good. We have lost one valuable horse, which was found dead in the morning with a ruptured stomach, no doubt the consequence of an attack of colic. One breeding sow was found dead, and post-mortem examination revealed internal hemorrhage as the apparent cause of death. The presence of a skewer in swill fed to our hogs caused the death of another. The kinds and numbers of the several classes of live stock are shown below: —

Horses. — French Coach, 1 stallion, 1 mare, 3 fillies; Percheron, 1 stallion; German Coach, 1 mare; French Coach, half blood, 2 colts; Percheron, three-fourths blood, 2 mares, 1 yearling gelding; work horses, 3.

Neat Cattle. — Jersey, 1 bull, 4 cows, 2 heifers, 1 calf; Holstein-Friesian, 1 bull, 4 cows; Ayrshire, 1 bull, 4 cows; Shorthorn, 1 bull, 1 cow; grade, 32 cows, 9 heifers, 12 calves; 1 Jersey bull calf; total, 74 head.

Sheep. — Southdown, 4 breeding bucks, 50 ewes, 2 lambs; total, 56 head.

Swine. — Berkshire, 1 boar, 5 sows; Yorkshire, 5 sows; shoats, 47; total, 58 head.

THE MILK RECORD.

The policy of disposing of the least satisfactory cows in our herd has been continued during the past year, and a few superior grade cows have been purchased. The average product for the year shows a marked improvement, as compared with recent years. The average number of cows milked during the year is 35⅙. The total yield of milk has been 232,463 pounds, — an average per cow of 6,610 pounds. The average butter fat test for the herd is about 4.2 per cent., which makes an average yield of butter fat per individual cow of 277.62 pounds, which is the equivalent of about 319 pounds of butter per cow per year.

IMPROVEMENTS.

The principal improvements of the past year are as follows: —

About two additional acres in Durfee pasture have been cleared of stumps, and most of this is plowed and ready for a crop. The four acres which had been previously cleared have been seeded, and the condition of the grass indicates a very satisfactory crop next season.

About one acre of land lying on either side of the road running between the Durfee pasture and the south flat has been improved by the removal of an enormous quantity of rubbish which had been deposited there while the place was used as a public dump, and by grading, plowing and seeding. This work greatly improves the appearance, and the land by the roadside will now yield a profitable crop of grass.

Considerable work in the way of improvement has also been done in the neighborhood of the rifle butt and in the ravine.

THE FARM FINANCES.

The cash receipts for the year are $6,680.94, and there is due on accounts for sales made during the year the sum of $79.38; this, added to the cash receipts, makes a total of $6,760.32. Last year the similar total was $10,009.49; there is a decrease, therefore, for this year of $3,249.17. The total expenses of this year have amounted to $10,470.79. The inventory at the present time amounts to $17,912.58, which is $878.27 less than the inventory of last year. Although the machines, implements, vehicles, etc., of the farm have suffered the usual depreciation from use, the decrease in the inventory is the consequence mainly of a more discriminating valuation. The decrease is confined entirely to the items which make up the equipment of the farm. The cash received during the year has been derived from the following sources: for milk and cream, $3,125.50; cattle, including calves for veal, $1,385; horses, including fees for the use of stallions, $241.50; swine, $198.71; sheep, $120.27; hay, $86.61; potatoes, $445.66; celery, $122.46; team labor, $1,084.95; manual labor, $52.36; and sundries, $680.33.

WM. P. BROOKS,
Professor of Agriculture.

AMHERST, Dec. 26, 1904.

MILITARY DEPARTMENT.

President H. H. GOODELL, *Massachusetts Agricultural College.*

SIR: — I have the honor to submit the following report of the military department of this college for the year ending Dec. 31, 1904.

Instruction has been both practical and theoretical, conducted in compliance with the college schedule and regulations.

Under the provisions of General Orders, No. 65, War Department, dated April 6, 1904, educational institutions at which regular army officers are detailed for duty are divided into three classes, designated A, B and C, and the course of military instruction prescribed for each. Under the provisions of the above-mentioned order this college is placed in Class B, and the following course of instruction prescribed, viz.: —

Practical. — Infantry drill regulations through the school of the battalion, in close and extended order; advance and rear guards, outposts and marches; the ceremonies of battalion parade, review, inspection and escort of the colors; infantry target practice; instruction in first aid to the injured; a guard to be mounted five times in each week of the school year, weather permitting, and the guard practically instructed for one hour in the posting and relief of sentinels and their duties, the latter to be outside the hours provided for other ceremonies.

Theoretical. — Infantry drill regulations covered by practica instruction; the manual of guard duty; small arms firing regulations, and the most important of the articles of war; records which pertain to the administration of a company; ten lectures during the course of each school year on various military subjects, notes to be taken by the students, and made the basis of subsequent recitations.

This order has been complied with as far as it pertains to theoretical instruction, but only with the senior and freshman classes, as per college schedule. The order relating to practical instruction has been complied with only as provided by college schedule, — three hours per week, as scheduled, with the addition of certain exercises from 8.30 to 10.30 A.M. every Saturday, instituted to satisfy demerits incurred in the military department, such as unauthorized absence from drill or inspection, or rooms, arms and equipments or uniform not in proper condition.

The hours of regular drill are from 3.45 to 4.45 P.M., every Monday, Tuesday and Thursday. All rooms occupied by students in dormitories, all closets, sinks, etc., are carefully inspected every Saturday morning, and special attention paid to sanitation. Students not otherwise engaged are required to be present at these inspections. The order of drill commences with small squads for freshmen, and continues until they are sufficiently instructed for assignment to companies, after which the exercises include all drills and ceremonies prescribed for company and battalion. On account of the inclemency of the weather during the winter, all drills and ceremonies are conducted in the drill hall, and, in order to avoid tedious monotony, embrace infantry manual of arms; field artillery, single gun detachment only; gallery practice, consisting of firing at an iron target with the service rifle and reduced charge of powder; sighting and aiming drill; Butt's "Manual of Physical Drill;" first aid to the injured; and signal drill.

Most of the students have had target practice during the past year, at short ranges, with the old Springfield cadet rifle. The results obtained have not been entirely satisfactory, owing to the limited time at my disposal. A student who is given an opportunity to practice on the range only a few times during the whole year, and these times limited to the drill hour, cannot be expected to manifest much enthusiasm. This is a subject which is given great weight in all military organizations, both regular and militia, and should receive greater consideration in this college. To become a good marksman requires intelligent instruction on the range, a careful study of the mechanism of the rifle, and frequent practice under various conditions of weather. In all previous annual reports I have recommended that the student body be allowed to go into camp for one week in each college year, about the first week in May, and the time devoted to practical instruction in field service, such as guard and outpost duty, target practice, construction of shelter trenches and castrametation. I consider this of inestimable value to all military students, but have not yet been able to carry it out, from lack of the necessary camp and garrison equipage.

In theoretical instruction I have given more than the required lectures on the subjects prescribed. I have had recitations from the senior class every Monday, and from the freshman class every Monday, Tuesday and Thursday. On account of the large class and the inadequacy of the lecture room it has been divided into three sections, so that I am able to meet all of the class once each week.

I beg to repeat the recommendation made in my last annual report, that a physician be employed and paid by the State, to devote one or two hours each day attending upon any of the students who may require such service. In addition to the reasons assigned in this recommendation, it will also prevent the danger of spreading contagious disease. I respectfully invite special attention to this subject.

All the buildings under my supervision are in good condition except the drill hall, which is greatly in need of shingling. This recommendation has been made in previous reports, but it has been found impossible to carry it out. The plumbing in all the buildings appears to be in good sanitary condition.

By act of Congress of Jan. 21, 1903, every ablebodied male citizen of the United States, between the ages of eighteen and forty-five years, is made a member of the militia, which is divided into two classes, the organized and unorganized, the organized militia to be known as the National Guard, and the unorganized to be known as the Reserve Militia. The same act authorizes the President to call forth such militia, from one or both classes, whenever it becomes necessary to suppress rebellion, to repel invasion or to execute the laws of the United States. The primary object of military instruction in educational institutions is to fit young men to hold commissions in such forces whenever called out. It has also a tendency to inculcate the spirit of patriotism in college students, by making them realize that, as citizens of the country, they owe a duty to it which they are liable to be called upon to discharge in a position of honor and trust. The true spirit of patriotism should dominate all military instruction, for without it tactical education is of little or no value.

Under the provisions of General Orders No. 94, War Department, 1902, the following-named students of the class of 1904 were reported to the Adjutant-General of the Army and the Adjutant-General of the Commonwealth as having shown special aptitude in the military department, viz.: Fayette D. Couden, Howard M. White and Clarence H. Griffin.

The following is a list of ordnance and ordnance stores on hand, property of the United States, in possession of the college, viz.: —

2	3.2-inch breech-loading steel guns, with implements complete.
2	8-inch mortars, with mortar beds and implements.
2	carriages and limbers for 3.2 B. L. steel rifles.
147	Springfield cadet rifles, model 1884.
147	sets infantry accoutrements.
51	headless shell extractors.
1	set reloading tools.
6	non-commissioned officers' swords, steel scabbards.
14	non-commissioned officers' waist belts and plates.
50	blank cartridges for field guns.
4,000	metallic rifle ball cartridges, calibre 45.
4,500	metallic blank cartridges, calibre 45.
250	friction primers, radial, for field guns.
10,000	cartridge primers, small arms.
4,000	round balls for gallery practice.
25	pounds of powder, small arms, reloading.
8.000	pasters, black and white.
150	paper targets, "A" and "B."
1	set of marking rods, disks and brushes for gallery practice.

All this property is in good condition and well cared for. The Springfield cadet rifles are old and obsolete. It is very desirable to exchange them for the more modern rifle as soon as it can be done. I am informed, however, that this cannot be done until all the troops of the regular army and national guard have been supplied. It might be possible to obtain the "Krag Jorgensen" rifle, which is a great improvement over the old ones we now have; but this has recently been discarded by the regular army, and the improved Springfield, magazine rifle, calibre 30, adopted in its place, hence the "Krag Jorgensen" is now obsolete. It will, no doubt, be a long time before the new Springfield will be issued to colleges.

The military organization at present is as follows: one battalion of two companies of infantry, staff and band. For the purpose of battalion drill and ceremonies the two companies are equalized into four.

Commandant.

JOHN ANDERSON,	Major, U. S Army, Retired.

Staff and Non-commissioned Staff.

Cadet Adjutant,	First Lieut. EDWIN W. NEWHALL, Jr.
Cadet Quartermaster,	First Lieut FRANCIS A. BARTLETT.
Cadet Sergeant-Major,	EDWARD T. LADD.
Ordnance Sergeant,	JOHN J. GARDNER.

Priv. HUGH L. BARNES, battalion clerk.

Band.

CHARLES S. HOLCOMB,	Chief musician, with rank of first lieutenant.
PERCY F. WILLIAMS,	Principal musician, with rank of first sergeant.
LEWELL S. WALKER,	Sergeant.
LOUIS H. MOSELEY,	Corporal.
STANLEY S. ROGERS,	Corporal.

Privates, 14; aggregate, 19.

Company A.

FREDERICK L. YEAW,	Cadet Captain.
GRENVILLE N. WILLIS,	Cadet First Lieutenant.
JOHN F. LYMAN,	Cadet Second Lieutenant.
GEORGE W. PATCH,	Cadet First Sergeant.
WALTER B. HATCH,	Cadet Sergeant.
BERTRAM TUPPER,	Cadet Sergeant.
CLARENCE W. LEWIS,	Cadet Sergeant.
NORMAN D. INGHAM,	Cadet Sergeant.
WILLIAM M. SEARS,	Cadet Corporal.
ARTHUR W. HALL, Jr.,	Cadet Corporal.
HERMAN A. SUHLKE,	Cadet Corporal.
FRY C. PRAY,	Cadet Corporal.
WALTER E. DICKINSON,	Cadet Corporal.
WILLIAM W. COLTON,	Cadet Corporal.
BENJAMIN STRAIN,	Cadet Corporal.

Total, Company A, 3 officers, 5 sergeants, 7 corporals, 54 privates; aggregate, 69.

Company B.

GEORGE H. ALLEN,	Cadet Captain.
WILLARD A. MUNSON,	Cadet First Lieutenant
ALBERT D. TAYLOR,	Cadet Second Lieutenant.
CHESTER L. WHITAKER,	Cadet First Sergeant.
THOMAS F. HUNT,	Cadet Sergeant.
JAMES R. KELTON,	Cadet Sergeant.
RICHARD L. ADAMS,	Cadet Sergeant.
HARVEY D. CROSBY,	Cadet Sergeant.
DANIEL H. CAREY,	Cadet Corporal.
JAMES E. MARTIN,	Cadet Corporal.

Frederick C. Peters,	Cadet Corporal.
George T. French,	Cadet Corporal.
Charles A. Tirrell,	Cadet Corporal.
Ralph W. Peakes,	Cadet Corporal.
Alexander H. M. Wood,	Cadet Corporal.

Total, Company B, 3 officers, 5 sergeants, 7 corporals, 55 privates; aggregate, 70.

Total in military department: 2 captains, 7 lieutenants, 14 sergeants, 16 corporals, 124 privates; aggregate, 163. Aggregate in military department last year, 139, — a net increase of 24.

Respectfully submitted,

JOHN ANDERSON,

Major, U. S. Army, Retired, Commandant.

REPORT OF THE PRESIDENT OF THE MASSACHUSETTS AGRICULTURAL COLLEGE TO THE SECRETARY OF AGRICULTURE AND THE SECRETARY OF THE INTERIOR, AS REQUIRED BY ACT OF CONGRESS OF AUG. 30, 1890, IN AID OF COLLEGES OF AGRICULTURE AND THE MECHANIC ARTS.

I. Receipts for and during the Year ended June 30, 1904.

1. State aid: —	
(*a*) Income from endowment,	$1,919 19
(*b*) Appropriation for current expenses,	21,000 00
2 Federal aid: —	
(*a*) Income from land grant, act of July 2, 1862,	3,650 00
(*b*) Additional endowment, act of Aug. 30, 1890,	16,666 66
(*c*) For experiment stations, act of March 2, 1887,	15,000 00
3. Fees and all other sources,	3,292 00
Total,	$61,527 85

II. Property, Year ended June 30, 1904.

Value of buildings,	$248,775 00
Value of other equipment,	184,243 35
Total number of acres,	404
Acres under cultivation,	275
Acres used for experiments,	60
Value of farm and grounds,	$44 350 00
Number of acres of land allotted to State under act of July 2, 1862,	360,000
Amount of land grant fund of July 2, 1862,	$219,000 00
Amount of other permanent funds,	141,575 35
Number of bound volumes in library June 30, 1904,	25,268

III. Faculty during the Year ended June 30, 1904.

1. College of Agriculture and Mechanic Arts, collegiate and special classes,	26
2. Number of staff of experiment station,	22

IV. Students during the Year ended June 30, 1904.

1 College of Agriculture and Mechanic Arts, collegiate and special courses,	213
2. Graduate courses,	7
Total, counting none twice,	220

SEVENTEENTH ANNUAL REPORT

OF THE

HATCH EXPERIMENT STATION

OF THE

MASSACHUSETTS AGRICULTURAL COLLEGE.

JANUARY, 1905.

HATCH EXPERIMENT STATION

OF THE

MASSACHUSETTS AGRICULTURAL COLLEGE,

AMHERST, MASS.

OFFICERS.

HENRY H. GOODELL, LL.D.,	*Director.*
WILLIAM P. BROOKS, PH.D.,	*Agriculturist.*
GEORGE E. STONE, PH.D.,	*Botanist.*
CHARLES A. GOESSMANN, PH.D., LL.D.,	*Chemist* (fertilizers).
JOSEPH B. LINDSEY, PH.D.,	*Chemist* (foods and feeding).
CHARLES H. FERNALD, PH.D.,	*Entomologist.*
FRANK A. WAUGH, M.S.,	*Horticulturist.*
J. E. OSTRANDER, C.E.,	*Meteorologist.*
HENRY T. FERNALD, PH.D.,	*Associate Entomologist.*
FREDERICK R. CHURCH, B.SC.,	*Assistant Agriculturist.*
NEIL F. MONAHAN, B.SC.,	*Assistant Botanist.*
HENRI D. HASKINS, B.SC.,	*First Assistant Chemist* (fertilizers).
EDWARD G. PROULX, B.SC.,	*Second Assistant Chemist* (fertilizers).
EDWARD B. HOLLAND, M.S.,	*First Chemist* (foods and feeding).
PHILIP H. SMITH, B.SC.,	*Assistant Chemist* (foods and feeding).
ERWIN S. FULTON, B.SC.,	*Assistant Chemist* (foods and feeding).
ALBERT PARSONS, B.SC.,	*Inspector* (foods and feeding).
SUMNER R. PARKER, B.SC.,	*Dairy Tester* (foods and feeding).
JOSEPH G. COOK, B.SC.,	*Assistant in Foods and Feeding.*
GEORGE O. GREENE, M.S.,	*Assistant Horticulturist.*
GEORGE W. PATCH,	*Observer.*

The co-operation and assistance of farmers, fruit-growers, horticulturists and all interested, directly or indirectly, in agriculture, are earnestly requested. Communications may be addressed to the "Hatch Experiment Station, Amherst, Mass."

The following bulletins and reports are still in stock, and can be furnished on demand : —

No. 27. Tuberculosis in college herd; tuberculin in diagnosis; bovine rabies; poisoning by nitrate of soda.
No. 33. Glossary of fodder terms.
No. 35. Agricultural value of bone meal.
No. 41. On the use of tuberculin (translated from Dr. Bang).
No. 57. Fertilizer analyses.
No. 64. Analyses of concentrated feed stuffs.

No. 67. Grass thrips; treatment for thrips in greenhouses.

No. 68. Fertilizer analyses.

No. 75. Fertilizer analyses.

No. 76. The imported elm-leaf beetle.

No. 77. Fertilizer analyses.

No. 79. Growing China asters.

No. 81. Fertilizer analyses; treatment of barnyard manure with absorbents; trade values of fertilizing ingredients.

No. 82. Orchard management; cover crops in orchards; pruning of orchards; report on fruits.

No. 83. Fertilizer analyses.

No. 84. Fertilizer analyses.

No. 86. Orchard treatment for the San José scale.

No. 87. Cucumbers under glass.

No. 89. Fertilizer analyses; ash analyses of plants; instructions regarding sampling of materials to be forwarded for analysis.

No. 90. Fertilizer analyses.

No. 91. Injuries to shade trees from electricity.

No. 92. Fertilizer analyses.

No. 93. Concentrated feeds.

No. 95. Fertilizer analyses; notes on barnyard manure; trade values of fertilizing ingredients.

No. 96. Fungicides; insecticides; spraying calendar.

No. 97. A farm wood lot.

No. 98. Inspection of concentrates.

No. 99. Dried molasses beet pulp; the nutrition of horses.

No. 100. Fertilizer analyses; market values of fertilizing ingredients.

No. 101. Inspection of concentrates.

Special bulletin, — The coccid genera Chionaspis and Hemichionaspis.

Technical bulletin, No. 1, — Greenhouse Aleyrodes; strawberry Aleyrodes.

Technical bulletin, No. 2, — The graft union.

Index, 1888–95.

Annual reports for 1897, 1898, 1899, 1900, 1901, 1902, 1903, 1904.

Of the other bulletins, a few copies remain, which can be supplied only to complete sets for libraries.

ANNUAL REPORT

OF GEORGE F. MILLS, *Treasurer* OF THE HATCH EXPERIMENT STATION OF MASSACHUSETTS AGRICULTURAL COLLEGE,

For the Year ending June 30, 1904.

Cash received from United States Treasurer, . . .		$15,000 00
Cash paid for salaries, ...	$6,012 05	
for labor, ...	3,070 03	
for publications, ...	1,017 89	
for postage and stationery, . .	297 42	
for freight and express, . .	116 30	
for heat, light, water and power,	477 95	
for chemical supplies, . . .	25 40	
for seeds, plants and sundry supplies,	408 19	
for fertilizers, ...	1,331 20	
for feeding stuffs, . . .	401 28	
for library, ...	31 70	
for tools, implements and machinery,	221 33	
for furniture and fixtures, . .	509 31	
for scientific apparatus, . .	318 21	
for live stock, ...	313 50	
for travelling expenses, . .	137 02	
for contingent expenses, . .	10 00	
for building and repairs, . .	301 22	
		$15,000 00

Cash received from State Treasurer, . . .	$13,000 00	
from fertilizer fees, . .	4,204 58	
from farm products, . .	2,714 79	
from miscellaneous sources, .	3,606 92	
Balance June 30, 1903, ...	3,198 56	
		$26,724 85

Cash paid for salaries, ...	$13,134 20
for labor, ...	1,985 23
Amount carried forward, . . .	$15,119 43

Amount brought forward,	$15,119 43	
Cash paid for publications,	1,415 18	
for postage and stationery,	551 11	
for freight and express,	161 96	
for heat, light, water and power,	405 88	
for chemical supplies,	450 71	
for seeds, plants and sundry supplies,	321 52	
for fertilizers,	3 70	
for feeding stuffs,	840 60	
for library,	215 80	
for tools, implements and machinery,	100 34	
for furniture and fixtures,	340 15	
for scientific apparatus,	952 56	
for live stock,	375 75	
for travelling expenses,	1,757 08	
for buildings and repairs,	329 53	
Balance,	3,383 55	
		$26,724 85

I, Charles A. Gleason, duly appointed auditor of the corporation, do hereby certify that I have examined the accounts of the Hatch Experiment Station of the Massachusetts Agricultural College for the fiscal year ended June 30, 1904; that I have found the same well kept and classified as above; that the receipts for the year from the Treasurer of the United States are shown to have been $15,000, and the corresponding disbursements $15,000; for all of which proper vouchers are on file and have been by me examined and found correct, thus leaving no balance of the $15,000; and that $3,383.55 are left of the State appropriation and of funds received from miscellaneous sources.

CHARLES A. GLEASON,
Auditor.

AMHERST, Aug. 15, 1904.

REPORT OF THE BOTANIST.

G. E. STONE, N. F. MONAHAN, ASSISTANT.

With the exception of a continual increase in our correspondence, the same routine has been pursued as in previous years. Experiments have been carried on in the greenhouse as usual on problems connected with roses, carnations, tomatoes, melons and violets. There are obscure diseases connected with these crops, which are in need of further study in order to throw more light on some practical methods of controlling or eliminating them.

Work has been continued on the effects of illuminating gas on trees, — a subject which is becoming important to communities. This matter is receiving attention in various States, on account of the not infrequent destruction of avenues of valuable shade trees. Experiments of various kinds pertaining to electricity and plant life in general have also received some attention. There is an increased interest in this subject, more particularly relating to the injurious effects which are too frequently manifested in valuable shade trees coming in contact with live wires. The department has also given considerable attention to the study of soil organisms, but this work at present is merely in a preliminary stage.

CROPS AS RELATED TO WEATHER CONDITIONS.

Every season is distinctly peculiar as regards the prevalence or non-prevalence of specific fungous growths. The early potato blight appeared in most places to do more injury than usual during the early part of the summer. This is true even where crops were sprayed. As far as this season's results are concerned, it would indicate that spraying was not commenced early enough for controlling this blight.

Most potatoes ought to have been sprayed as early as June 12 or 15, in order to check the blight, or, in other words, when they were less than one-third grown. In regard to the mildew and wet rot on the potatoes, the effects were severe in some localities, and much loss was experienced.

The asparagus rust was more pronounced than last season. A stem rot caused much damage to cultivated dandelions, — a trouble which appears to be an unusual one in this State. Cucumber and melon blight have been exceedingly rare the past summer, being the first for about six years when no trouble has been experienced. The downy mildew (*Plasmopara Cubensis*, (B. and C.) Humphrey) of cucumbers and melons, which is believed to work its way north from the south each year, did not meet our attention once during the season. On the other hand, Alternaria and Anthracnose have existed here and there, but did no appreciable harm.

The worst injuries were due to winter-killing. In our last report we alluded briefly to disastrous effects of winter-killing of various shrubs and plants, caused by the unusual prolonged fall of 1902, and the severe and sudden cold occurring in December of that year. The winter of 1903 and 1904 was even more severe than the preceding one in causing injury to plants, and this injury showed itself in a different manner. Last winter was particularly characterized as causing severe injury to native plants, as well as exotic ornamentals. The effect of the extreme cold on plants was, moreover, quite different in the winter preceding, inasmuch as in 1902 and 1903 freezing of the tender wood above ground largely took place, while the effects of last winter's freeze extended both above and below the surface of the ground. The most characteristic feature of the last winter-killing was the injury done to the roots. This was particularly noticeable on apple, pear and plum trees, and the white pine suffered to a considerable extent in some localities. Many ornamental shrubs and vines also show the same characteristic effects of root killing. Numerous apple trees were killed outright, and thousands lost a greater or less number of limbs, due to an inadequate root system to supply them. Pear trees did not seem to be affected so extensively as the apple. We observed pear trees which had their trunks split open two or three inches by the frost. The crevices eventually closed and commenced to heal over in the spring, although the effects of partial root killing have left many of them in a bad condition. The splitting of the stem is what is termed sun scald or frost crack, and the frost and sun are believed to be responsible for it. One of the characteristic results of partial root killing is that the trees will bear leaves in the spring and appear normal for a while, when suddenly the leaves commence to turn yellow and brown, and finally dry up and drop off. If only part of the root system is injured, the effects will show only on one or more branches or limbs ; but when a large portion of the root system is involved, the whole tree is likely to collapse. The development of the leaves of many apple trees, and in some instances of peach and plum trees which had partially leaved out, was suddenly arrested, and they remained in this condition all summer.

White pines in some localities appeared to be injured extensively by cold, and such native species as the white ash, red and sugar maples, birches and poplars showed the effects of the severe winter. The red maples exhibited in many cases a scarcity of foliage, especially near the top ; and more dead wood than usual was observed in some of the other species noted. The effects of root killing show more conspicuously when the soil moisture becomes reduced, and in many cases not until the season had become quite advanced did some trees show the effects of winter-killing. The effects on exotic plants were more severe than in 1902, since, in addition to the part above ground, the roots were injured.

Japanese maples, Japanese clematis, California privet, deutzia, roses, barberries, viburnums, etc., suffered to a considerable extent, and many were killed outright. This list could be greatly extended, and if complete would far exceed that noted in our last report. Sycamore and Norway maples have suffered from the loss of new wood during the past two years, as shown by the death of terminal branches. Grape vine roots were affected in many cases, and in some instances the maturing fruit wilted and dried up as if affected by the black rot.

On the whole, the season can be characterized as showing an unusual amount of winter-killing; in fact, more than has been seen for many years in this State.

TESTING OF SEED.

This department has frequently been called upon to do more or less of this work for farmers, and in many instances for seedsmen. Practically all seedsmen test their own seed; when, however, there is some doubt as to the germinating capacity, it occasionally becomes necessary to submit the seeds to a third party for results; in such cases the station is called upon to make tests. During the past year 120 samples have been tested for farmers and seedsmen.

THE PRACTICE OF SOIL STERILIZATION.

The application of steam under more or less high pressure to greenhouse soils contaminated with sterile fungi, and the use of hot water for partial sterilization, have been practised for a few years by greenhouse growers. We have had considerable experience with growing crops in sterilized soil, and some greenhouse growers have annually resorted to this method of treatment. It is our purpose to give a résumé of the results obtained from this practice.

Sterilization has been the means of lessening the amount of infection in lettuce houses in plants affected with drop and Rhizoctonia, and also of ridding houses of eel worms. It has also been the means of greatly stimulating the growth of crops; and in this respect it is likely to do as much harm as good, when intelligent supervision is not given to the crop. Some greenhouse men have resorted to sterilization for no other purpose than merely to try it, their houses being free from any infection for which this method of treatment could be recommended; while others have followed the practice of sterilizing for the purpose of modifying the growth and texture of their plants.

Besides the desired effect upon the eradication of drop and Rhizoctonia in lettuce houses, it has been the means of modifying to a large extent the texture of lettuce, and it has been employed as a stimulator. It has also been successful in eradicating troublesome insect pests. Its principal drawbacks, however, in growing lettuce, have been due to its stimulating effects on the plant itself, which, where proper precautions are not taken as regards temperature, etc., result in developing a more tender plant, with a loose and less desirable head. A lettuce plant of this type is more tender because it contains more water, and it is not so desirable for the market. Moreover, such plants are inclined to be susceptible to Botrytis rot, if not properly handled. We learned very early in our experiments that, on account of the stimulating effect brought about by growing plants in sterilized soils, it is necessary to hold the crop back by maintaining lower night temperatures. If a temperature of from 8° to 10° F. lower than is customary at night is maintained, so that the crop may develop no faster than one grown under normal conditions, the result will be a crop possessing firm heads of equal texture and resisting qualities to that grown under normal conditions. We have repeatedly called attention to the necessity of this practice in growing lettuce in sterilized soils, but this advice has not always been followed.

There has been a slight increased tendency for lettuce plants to become more subject to Botrytis rot when grown in either sterilized soil or that treated by hot water, owing to a more accelerated growth, and the production of a head of less firm texture. Botrytis rot is the principal disease that most lettuce crops are troubled with at the present time. However, it is not a very serious one with good growers. There will be observed here and there a plant affected with Botrytis rot in the best of houses; the ideal conditions, however, require that there should be none. As to the loss by Botrytis rot by experienced growers, it is of no practical importance, since the percentage will be represented by a small decimal. Botrytis rot can, nevertheless, be eliminated to a greater extent than it is, if lettuce growers would follow certain precautions more carefully. In growing plants in sterilized soil, Botrytis rot can be reduced by paying attention to proper temperature conditions at night, or, in other words, by holding the crop within legitimate limits. The principal sources of Botrytis infection are inferior prickers or seedlings. All prickers showing the black root should be discarded, as this is the beginning of the Botrytis rot. No prickers showing any injuries to the leaves, roots or cotyledons should be utilized, nor should any dead leaves be allowed to form on the plants or be left on them after transplanting. A strict adherence to the above precautions will greatly reduce Botrytis rot.

Another feature which should be considered in connection with the Botrytis rot, as well as rots in general, is watering. Lettuce growers have developed the tendency to do less watering after the crop is set than formerly. They apply most of the water previous to planting, at the present time. This practice induces the plant to develop a better root system. The surface of the soil becomes dry and remains so, which constitutes a great feature in eliminating Botrytis rot, drop, etc. Were it possible for air and sun to obtain access to a lettuce stem, there would scarcely be known such a thing as lettuce rot, with the present skill developed in handling this crop. Some growers have practised for some time the method of thoroughly wetting the soil before planting, and not applying any water after transplanting; while others water occasionally for only two or three weeks after transplanting. We demonstrated quite early in our work the importance of keeping the surface of the soil dry. Subirrigation methods reduce the rots to a considerable extent; and the method of thoroughly wetting the soil previous to planting, and not supplying any water afterwards, is similar in its effects to subirrigation, besides having the advantage of being a much cheaper method. Top coatings of clean, dry sand and other substances have similar effects in reducing rots.

We believe that a great deal can be accomplished in eliminating Botrytis rot and other diseases if more care be taken in selecting seed of a more uniform size and character. Care should be taken in selecting seed that will produce more hardy plants, and that which will produce plants less subject to infection. There is a chance for experimentation and more careful study here.

In one instance we have heard it implied that lettuce crops grown in sterilized soil were prone to mildew. This may result to some extent when the crop is not properly handled; but mildew is confined to the houses of only a very few commercial growers, and its existence in a house at all can be accounted for otherwise. We introduced the mildew into our house several times, but it always died out, and was never known to live through the summer. On the whole, far better lettuce crops are turned out to-day than five years ago, and there is a decided decrease in the amount of infection, due to the application of improved methods of treatment and culture.

As regards the effects of sterilized soil on the growth of cucumbers, our experiments and those of others have shown favorable results, since cucumbers will stand a considerable amount of forcing without any detriment; and we have none of the drawbacks due to excessive stimulation of the crop, such as we find in lettuce. When cucumbers are grown under single lights of glass, or under favorable conditions as regards light, the stimulating effects due to sterilization act most advantageously; while, on the other hand, where the crop is grown under exceedingly abnormal conditions as regards heat, light and moisture, as it sometimes is, no appreciable results are noticeable, except in so far as the treatment eliminates undesirable pests from the soil. Indeed, no form of stimulation is of any practical value to plants when their conditions of growth are extremely abnormal. Sterilization is especially efficacious in destroying eel worms and preventing timber rot, and also destroys some insect pests which trouble the cucumber. One of the special advantages in growing cucumbers in sterilized soil is connected with the seed and seedling, since germination of the seeds is hastened, the plants are accelerated, and damping-off is prevented. A considerable amount of acceleration is given to the growth of the seedling; and in our experiments, where seeds were sown in sterilized and unsterilized soil, we obtained an increase in the actual germination of the seed equal to 33 per cent. in favor of sterilized soil. The expense of sowing seeds and starting seedlings in sterilized soil would be slight, and the results obtained render this process especially desirable.

The growing of carnations in sterilized soil, according to our limited experiments, shows a slightly beneficial effect on the plant, although others who have had more extensive experience have noted very little difference as the result of this practice. It is especially applicable to carnations in eliminating the wet stem rot caused by the fungus Rhizoctonia. In our opinion, there is little reason to believe that sterilizing would succeed in preventing the dry rot caused by Fusarium. With carnations, soil sterilization possesses some advantage in the cutting bed where cuttings are affected with Rhizoctonia and the damping-off fungus (*Pythium De Baryanum*, Hesse). In our rather extensive use of sterilized soil we have never observed any detrimental influence on the soil itself; we have, however, always made use of a tolerably rich soil, well supplied with organic matter.

The principal forms of appliances now used for this purpose are similar, with some modifications, to those which have been employed for five or six years. Perforated iron pipes made up into frames, 10 to 12 feet long and 8 to 10 feet wide, are most generally used. The harrow form of apparatus, known as the Sargent sterilizer, is also largely used, and consists of an iron frame, 4 or 5 by 8 or 10 feet, provided with perforated teeth about 10 or 12 inches apart and 1 foot long. The teeth are thrust into the soil, and the steam is turned on. With this form of apparatus it is not necessary to shovel the soil, hence the process is cheap. The latter type requires a high pressure of steam, and not so great a volume; while the former apparatus requires a large volume of steam, and can be operated to advantage with 15 or 20 pounds of steam pressure.

THE INFLUENCE OF ELECTRICAL POTENTIAL ON THE GROWTH OF PLANTS.[1]

In our last report we gave results of experiments showing the effects of current electricity upon the growth of plants, also the results of subjecting plants and moist seeds to different electrical potentials. We shall give here the results of further experiments along similar lines, and present some results relating to differences of electrical potential which exist between locations in trees and corresponding situations more or less removed from them.

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[1] These experiments were conducted by N. F. Monahan.

In the first series of experiments we will consider the influence of electrical potential upon growth. In subjecting plants to an atmospheric charge of a certain potential we used a glass case such as is described in our preceding report, being, briefly, a glass case 3 feet 4 inches long, 2 feet 9 inches wide and 2 feet 11 inches high, with shellacked wooden frames and bottom. Another case, for comparison, and similar in structure but slightly larger, was also employed. Both cases were tolerably tight when closed, and were placed on movable trucks, from which they were well insulated, in a large greenhouse. The greenhouse screened out, as it were, the atmospheric electricity. At no time have we ever been able to detect any electrical potential in the air in greenhouses. The soil used in growing the plants was of uniform type, very carefully mixed; in fact, every precaution was taken to have the soil conditions the same in each case, and all its various constituents were thoroughly incorporated.

In the case which was to be treated was placed a small water-dripping apparatus, which served as a collector, and which indicated the degree of charging. The air was charged by means of a wire projecting into the case from a Topler-Holtz influence machine. All electrical readings were measured by a Thompson quadrant electrometer.

In the two experiments now described radish plants were employed, as they seemed to be most suitable for the condition under which they were grown. The seeds were of a uniform grade, and were sown in rows 3 inches apart and 1 inch apart in the rows. It was the intention to charge the case each morning to a potential of 150 volts; but this was impossible, as exactly 150 volts could not always be obtained, and at times, on account of the dampness of the air, no charge could be procured from the machine. The doors of both cases were kept closed for four hours after the charge had been induced into the treated case, and at the end of that time they were opened; therefore, for twenty out of every twenty-four hours all the plants were growing under the same conditions. At all times the conditions of temperature and moisture were practically the same in both charged and normal, or uncharged, cases.

TABLE I., EXPERIMENT I. (*Raphanus sativus* L.). — *Showing the Results obtained by electrically charging the Air in a Case.*

CASE.	Average Daily Charge (Volts).	Number of Plants.	TOTAL WEIGHT IN GRAMS OF —	
			Tops.	Roots.
Normal case, ...	-	219	2,211.3	510.3
Electrically charged case, .	167.2	162	2,551.5	623.7

TABLE I., EXPERIMENT I. (*Raphanus sativus* L.). — *Showing the Results obtained by electrically charging the Air in a Case* — Concluded.

CASE.	AVERAGE WEIGHT IN GRAMS OF —		PER CENT. GAINED IN WEIGHT OF —		Total Per Cent. gained.
	Tops.	Roots.	Tops.	Roots.	
Normal case, . . .	10.097	2.333	-	-	-
Electrically charged case,	15.750	3.850	55.98	65.67	57.67

The experiment in Table II. is similar to Experiment I., except that the seeds were planted in rows 5 inches apart, instead of 4, as in the preceding one. The cold weather interfered with the development of the plants, and the experiment was brought to a close earlier than was planned.

TABLE II., EXPERIMENT II. (*Raphanus sativus* L.). — *Showing the Results obtained by electrically charging the Air in a Case.*

CASE.	Average Daily Charge (Volts).	Number of Plants.	TOTAL WEIGHT IN GRAMS OF —	
			Tops.	Roots.
Normal case, ...	-	136	91	98.5
Electrically charged case, .	141.2	69	66	74.0

TABLE II., EXPERIMENT II. (*Raphanus sativus* L.). — *Showing the Results obtained by electrically charging the Air in a Case* — Concluded.

CASE.	AVERAGE WEIGHT IN GRAMS OF —		PER CENT. GAINED IN WEIGHT OF —		Total Per Cent. gained.
	Tops.	Roots.	Tops.	Roots.	
Normal case, . . .	.669	.724	-	-	-
Electrically charged case,	.955	1.072	42.73	49.46	45.58

The results given in tables I. and II. are quite similar. In Table I. there was a gain of 55.98 per cent. in the weight of tops or leaves and 65.67 per cent. in the weight of roots, over the uncharged plants; in Table II., the percentage given for the tops is 42.73 and for the roots 49.46. The total gain in Experiment I. is 57.67 per cent.; in Experiment II. it is 45.58 per cent. The average gain in both experiments was 49.35 per cent. for the tops or leaves, 57.56 per cent. for the roots and 51.62 per cent. as an average total gain for the electrically stimulated plants. The charge in Experiment I. averaged 167.2 volts; in Experiment II., 141.2 volts. The charge only lasted a few seconds in all instances, and practically disappeared from the atmosphere of the case in fifteen minutes.

Some measurements were occasionally made of a dozen typical plants from each case in Experiment I. The object in taking these measurements was, first, to show the difference in size and degree of acceleration, differentiation, etc., of the treated and untreated plants; and, second, to compare the electrically treated plants with those that were not treated, when the latter were practically in the same stage of development; or, in other words, the plants in the electrically charged case were compared with those in the untreated case on the day in which the measurements were made, and also five days later, when the development of the normal plants had reached practically the same stage as that of the plants in the electrically treated case. By this method any changes in the external configuration of the plants brought about by electrical stimulation could be noted.

Table III. shows the results of these measurements, and Table IV. gives a comparison between the leaves of the plants in the charged and uncharged cases, measurements being made August 15 and August 20, respectively.

TABLE III. — *Showing the Average of Some Measurements of Plants in Table I., Experiment I.*

Date.	CASE.	Width of Leaf (Centimeters).	Length of Blade (Centimeters).	Length of Petiole (Centimeters).	Length of Whole Leaf (Centimeters).
August 15,	Normal case, . . .	2.13	4.17	2.28	6.49
	Electrically charged case, .	2.66	5.33	4.34	10.16
	Difference, . . .	.53	1.16	2.06	3.67
August 20,	Normal case, . . .	2.79	4.83	3.35	8.10
	Electrically charged case, .	3.65	6.95	5.20	12.05
	Difference, . . .	.86	2.12	1.85	3.95

TABLE IV. — *Giving a Comparison between the Leaves of the Plants in the Charged and Uncharged Cases.*

Date.	CASE.	Width of Leaf (Centimeters).	Length of Blade (Centimeters).	Length of Petiole (Centimeters).	Length of Whole Leaf (Centimeters).
August 20,	Normal case, . . .	2.79	4.83	3.35	8.10
August 15,	Electrically charged case,	2.66	5.33	4.34	10.16
	Difference, . . .	.13	.50	.99	2.06

The results of these experiments show what was readily discernible with the naked eye; namely, that the length of leaves of the electrically treated plants was quite different from those of the normal or untreated plants, and that the width and length of the leaf blade and the length of the petioles of the plants in the electrically treated case exceeded those of the normal or untreated plants. When comparisons, however, are made of the plants in the electrically treated case of August 15 with those of the normal of August 20, or five days later, it will be observed that the width of the blade of the normal exceeded that of the treated one by .13 centimeters, and that the difference in the length of the blades, petioles and leaves in general was much less marked. The length of the blade, petiole and whole leaf in general was longer for identical periods of development in the electrically treated plants than in the normal or untreated, although the width of the blade was more generally marked in its development in the normal than in the plants in the electrically charged case. The morphological differentiation due to electrical stimulation is shown in these experiments.

The plants in the electrically charged case were of a lighter-green color, and they showed a greater tendency to leaf burn than did the normal plants. They also appeared to be more succulent, but moisture determinations made of the leaves at the close of the experiment showed no difference in this respect. The roots in the treated case were relatively more elongated than those in the untreated case. Whether this form of electrical treatment stimulates plants more than current electricity cannot definitely be determined, from the lack of a sufficient number of comparative results. However, these two experiments would indicate, both from naked-eye observations and from weights and measurements, that static charges act as more pronounced stimuli than current electricity when applied to soils. Electrical stimulation gives rise to effects similar to those caused by lack of light, or such as result from partial etiolation. The light-green color of the foliage and the elongated organs were similar to those noticed in plants grown in poorly lighted greenhouses in winter, and in shaded plants grown in the forest. Other kinds of electrical stimulation appear to have the same general effects on the plant.

Comparison of Atmospheric Electrical Potential in Trees and in the Free Air.

The idea has been advanced that trees, shrubs, and in fact all growing plants, must form a means by which the potential of the air and the earth is held in equilibrium. A living tree does not offer such an enormous resistance to the passage of electricity as dead wood does. We have charged small plants in the laboratory to a sufficiently high potential so that, when placed in the dark, sparks were emitted from many points of the leaves, and living plants will readily take charges from a static machine. It has also been maintained that trees modify the electrical potential of the atmosphere of their immediate surroundings.

Grandeau[1] and other experimenters have shown that when plants are grown under wire netting they develop less in a given space of time than do plants grown under similar conditions in every respect as regards light, etc., in the free atmosphere. The interpretation of this phenomenon is, that wire screens modify the atmospheric electrical potential, or absorb the electricity, as it were, to the detriment of the plant. This method of experimenting with wire nets we have employed only to a limited extent, and at present have not a sufficient number of results on which to report. Unfortunately, most of the experiments previously made in this line are open to severe criticism, from the fact that too few plants were employed, and different methods of surrounding the plants with wire netting prevailed, which accounts for occasional conflicting results. Grandeau obtained similar results by growing plants under a chestnut tree, as under a wire netting; and he concluded that it is probable that trees modify to a large extent the electrical potential of the atmosphere in their immediate neighborhood. The object we had in view in these experiments was to ascertain, among other things, whether trees did modify in any way the electrical potential of the atmosphere in their immediate vicinity. In order to ascertain whether there is any discernible difference between the atmospheric electrical potential in trees and in the free air, at corresponding height and location, we made a series of three readings daily from April to July, and daily readings during the remainder of the experiment, with collectors and a Thompson quadrant electrometer. These observations were started early in the spring, before any foliage had developed, and continued until after the leaves had fallen. A collector was placed in an elm tree, at a height of 40 feet above the ground, at a fork between two limbs from which it was insulated. The collector was situated about on a level with, or slightly above, the spread of the branches and leaves. The tree, however, was not in every respect a typical elm for this region, the head being high and close, with the branches drooping but little.

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[1] "Comptes rendus," T. LXXXVII., 1878, pp. 60, 265, 939. "Chimie et Physiologie appliquées a l'Agriculture et à la Sylviculture par L. Grandeau," Paris, 1879, p. 279.

The collector in the tree is designated as II. in the following monthly records; and the one in the free air, which was located near a building, is designated as I. Collector III. was in a spruce tree, and Nos. IV. and V. were added in August. Collector III. was located 12 feet high, near the top and under the branches of a small Norway spruce. Nos. IV. and V. represent readings from two small Norway spruce trees, about 2 feet high, in pots; they were located about 16 feet from the ground, on a plank scaffold. No. IV. had a copper plate in the soil, which was connected with the electrometer when readings were made. No. V. had a similar plate, but was grounded with an insulated wire; another wire led from this copper plate in the soil to the electrometer.

Readings were taken from the various collectors on the same electrometer at practically the same time each day. Table V. shows readings taken from April 20 to Nov. 1, 1904, and where readings are omitted they could not be obtained. All readings not otherwise recorded imply negative potential.

TABLE V. — *Records showing the Electrical Potential (Volts) taken from an Elm Tree and from Free Air.*

DATE.	9 A.M.		1 P.M.		5 P.M.	
	Collector I. — Free Air.	Collector II. — Elm.	Collector I. — Free Air.	Collector II. — Elm.	Collector I. — Free Air.	Collector II. — Elm.
1904.						
April 21, . .	56.0	56.0	32.0	32.0	0.0	0.0
22, . .	48.0	48.0	32.0	32.0	16.0	16.0
23, . .	8.0	8.0	40.0	40.0	-	-
24, . .	16.0	16.0	16.0	16.0	16.0	-
25, . .	40.0	40.0	40.0	40.0	16.0	16.0
26, . .	32.0	32.0	16.0	16.0	32.0	32.0
27, . .	-	-	60.0	60.0	40.0	40.0
28, . .	8.0	8.0	32.0	32.0	45.0	45.0
29, . .	24.0	0.0	8.0	0.0	0.0	0.0
30, . .	32.0	32.0	-	-	-	-

April 24, trees show signs of budding.

TABLE V. — *Records showing the Electrical Potential (Volts) taken from an Elm Tree and from Free Air* — Continued.

DATE.	9 A.M.		1 P.M.		5 P.M.	
	Collector I. — Free Air.	Collector II. — Elm.	Collector I. — Free Air.	Collector II. — Elm.	Collector I. — Free Air.	Collector II. — Elm.
1904.						
May 1, . .	112.0	112.0	32.0	32.0	0.0	0.0
2, . .	16.0	16.0	12.0	12.0	8.0	8.0
3, . .	48.0	48.0	40.0	40.0	48.0	48.0
4, . .	56.0	56.0	24.0	24.0	24.0	24.0
5, . .	56.0	56.0	56.0	56.0	8.0	0.0
6, . .	12.0	12.0	24.0	24.0	20.0	20.0
7, . .	64.0	64.0	28.0	24.5	-	-
8, . .	-	-	-	-	-	-
9, . .	-	-	-	-	-	-
10, . .	24.0	24.0	28.0	28.0	-	-
11, . .	48.0	48.0	8.0	8.0	16.0	16.0
12, . .	72.0	72.0	80.0	80.0	40.0	40.0
13, . .	64.0	64.0	8.0	0.0	24.0	20.0
14, . .	16.0	14.0	-	-	-	-
15, . .	8.0	0.0	8.0	0.0	-	-
16, . .	-	-	-	-	-	-
17, . .	-	-	32.0	-	-	-
18, . .	-	-	20.0	8.0	20.0	-
19, . .	40.0	32.0	32.0	17.0	16.0	12.0
20, . .	56.0	40.0	32.0	24.0	-	-
21, . .	8.0	0.0	16.0	9.0	20.0	16.0
22, . .	32.0	16.0	-	-	-	-
23, . .	8.0	4.0	16.0	8.0	32.0	24.0
24, . .	16.0	14.0	20.0	12.0	8.0	8.0
25, . .	218.0	32.0	16.0	16.0	20.0	16.0
26, . .	88.0	56.0	32.0	0.0	-	-
27, . .	-	-	-	-	-	-
28, . .	24.0	20.0	24.0	20.0	16.0	0.0
29, . .	32.0	0.0	28.0	0.0	-	-
30, . .	-	-	-	-	-	-
31, . .	-	-	-	-	-	-

May 7, leaves beginning to show; May 9, hardly a trace; May 14, trees fairly well leaved, seeds beginning to drop; heavy thunder showers on 26th; 5 P.M. readings gave extremely high and fluctuating potentials.

Table V. — *Records showing the Electrical Potential (Volts) taken from an Elm Tree and from Free Air* — Continued.

Date.	9 A.M.		1 P.M.		5 P.M.	
	Collector I. — Free Air.	Collector II. — Elm.	Collector I. — Free Air.	Collector II. — Elm.	Collector I. — Free Air.	Collector II. — Elm.
1904.						
June 1, . .	32.0	24.0	16.0	8.0	+8.0	−8.0
2, . .	-	-	-	-	-	-
3, . .	-	-	16.0	8.0	-	-
4, . .	-	-	16.0	8.0	-	-
5, . .	8.0	0.0	8.0	0.0	112.0	56.0
6, . .	20.0	0.0	8.0	0.0	0.0	0.0
7, . .	-	-	-	-	-	-
8, . .	-	-	-	-	-	-
9, . .	-	-	-	-	-	-
10, . .	-	-	16.0	8.0	8.0	0.0
11, . .	28.0	16.0	32.0	20.0	24.0	16.0
12, . .	72.0	56.0	8.0	0.0	8.0	0.0
13, . .	40.0	24.0	40.0	24.0	-	-
14, . .	8.0	0.0	32.0	0.0	-	-
15, . .	16.0	8.0	28.0	24.0	-	-
16, . .	8.0	0.0	8.0	0.0	-	-
17, . .	16.0	8.0	40.0	24.0	-	-
18, . .	36.0	24.0	28.0	20.0	16.0	0.0
19, . .	72.0	48.0	88.0	56.0	8.0	0.0
20, . .	32.0	20.0	16.0	8.0	8.0	0.0
21, . .	20.0	16.0	16.0	8.0	8.0	0.0
22, . .	20.0	8.0	-	-	-	-
23, . .	-	-	-	-	-	-
24, . .	-	-	-	-	-	-
25, . .	-	-	-	-	-	-
26, . .	-	-	-	-	-	-
27, . .	24.0	12.0	8.0	0.0	0.0	0.0
28, . .	16.0	12.0	8.0	trace	8.0	trace
29, . .	-	-	-	-	-	-
30, . .	-	-	-	-	-	-

June 2-4, rain; June 6-9, wet wire.

TABLE V. — *Records showing the Electrical Potential (Volts) taken from an Elm Tree and from Free Air* — Continued.

DATE.	9 A.M.		1 P.M.		5 P.M.	
	Collector I. — Free Air.	Collector II. — Elm.	Collector I. — Free Air.	Collector II. — Elm.	Collector I. — Free Air.	Collector II. — Elm.
1904.						
July 1, . .	-	-	-	-	-	-
2, . .	-	-	-	-	8.0	4.0
3, . .	-	-	-	-	-	-
4, . .	-	-	-	-	-	-
5, . .	36.0	16.0	32.0	20.0	32.0	20.0
6, . .	28.0	12.0	24.0	0.0	24.0	0.0
7, . .	88.0	56.0	8.0	0.0	8.0	0.0
8, . .	-	-	20.0	8.0	28.0	12.0
9, . .	12.0	0.0	48.0	24.0	36.0	20.0
10, . .	-	-	-	-	8.0	0.0
11, . .	24.0	8.0	24.0	0.0	24.0	0.0
12, . .	-	-	-	-	-	-
13, . .	-	-	-	-	-	-
14, . .	-	-	-	-	-	-
15, . .	-	-	-	-	-	-
16, . .	-	-	-	-	-	-
17, . .	-	-	-	-	-	-
18, . .	-	-	-	-	-	-
19, . .	12.0	0.0	8.0	0.0	8.0	trace
20, . .	12.0	trace	16.0	4.0	16.0	4.0
21, . .	16.0	trace	28.0	8.0	12.0	trace
22, . .	-	-	-	-	-	-
23, . .	-	-	-	-	-	-
24, . .	-	-	-	-	-	-
25, . .	-	-	-	-	-	-
26, . .	-	-	-	-	-	-
27, . .	-	-	-	-	-	-
28, . .	20.0	8.0	24.0	8.0	-	-
29, . .	-	-	-	-	-	-
30, . .	28.0	8.0	32.0	16.0	16.0	trace
31, . .	-	-	-	-	-	-

July 12-18, electrometer out of order; July 22-28, rain.

Table V. — *Records showing the Electrical Potential* (*Volts*) *taken from an Elm Tree and from Free Air* — Continued.

[Collector III., 12 feet high, in Norway spruce. Nos. IV. and V., readings taken from copper plates in soil. Time of observation, 9 A.M.]

Date.	Collector I. — Free Air.	Collector II. — Elm.	Collector III. — Spruce.	No. IV. — Small Spruce Tree, not grounded.	No. V. — Small Spruce Tree, grounded.
1904.					
August 1, . .	88.0	52.0	-	-	-
2, . .	0.0	0.0	-	-	-
3, . .	8.0	0.0	-	-	-
4, . .	-	-	-	-	-
5, . .	-	-	-	-	-
6, . .	72.0	40.0	-	-	-
7, . .	32.0	16.0	-	-	-
8, . .	96.0	56.0	-	-	-
9, . .	40.0	24.0	-	-	-
10, . .	8.0	0.0	-	-	-
11, . .	16.0	8.0	Very slight movement		
12, . .	56.0	32.0	+4.0	+4.0	+4.0
13, . .	8.0	trace	+trace	+trace	+trace
14, . .	96.0	56.0	+6.0	+8.0	+16.0
15, . .	24.0	16.0	+trace	+4.0	+trace
16, . .	32.0	16.0	trace	+8.0	+12.0
17, . .	0.0	0.0	+8.0	+8.0	+12.0
18, . .	+16.0	+8.0	—8.0	—8.0	—8.0
19, . .	40.0	20.0	0.0	trace	trace
20, . .	-	-	-	-	-
21, . .	72.0	40.0	+8.0	+8.0	+12.0
22, . .	8.0	+trace	+trace	+trace	+trace
23, . .	8.0	trace	+8.0	+4.0	+8.0
24, . .	48.0	24.0	0.0	trace	trace
25, . .	56.0	28.0	0.0	0.0	trace
26, . .	96.0	52.0	+8.0	+8.0	+12.0
27, . .	88.0	40.0	0.0	0.0	0.0
28, . .	40.0	24.0	0.0	0.0	0.0
29, . .	8.0	trace	0.0	0.0	0.0
30, . .	40.0	16.0	+2.0	+2.0	+2.0
31, . .	40.0	24.0	0.0	0.0	0.0

TABLE V. — *Records showing the Electrical Potential (Volts) taken from an Elm Tree and from Free Air* — Continued.

[Collector III., 12 feet high, in Norway spruce. Nos. IV. and V., readings taken from copper plates in soil. Time of observation, 3 P.M.]

DATE.	Collector I. — Free Air.	Collector II. — Elm.	Collector III. — Spruce.	No. IV. — Small Spruce Tree, not grounded.	No. V. — Small Spruce Tree, grounded.
1904.					
August 1, . .	80.0	40.0	-	-	-
2, . .	-	-	-	-	-
3, . .	8.0	0.0	-	-	-
4, . .	-	-	-	-	-
5, . .	-	-	-	-	-
6, . .	24.0	12.0	-	-	-
7, . .	40.0	24.0	-	-	-
8, . .	88.0	56.0	-	-	-
9, . .	24.0	12.0	-	-	-
10, . .	0.0	0.0	-	-	-
11, . .	8.0	0.0	0.0	0.0	0.0
12, . .	40.0	24.0	+4.0	+4.0	+4.0
13, . .	56.0	4.0	+trace	+trace	+trace
14, . .	24.0	12.0	+4.0	+trace	+4.0
15, . .	72.0	40.0	+4.0	+8.0	+12.0
16, . .	16.0	8.0	trace	trace	trace
17, . .	0.0	0.0	0.0	0.0	0.0
18, . .	0.0	0.0	0.0	0.0	0.0
19, . .	40.0	20.0	0.0	0.0	trace
20, . .	-	-	-	-	-
21, . .	40.0	24.0	+4.0	trace	12.0
22, . .	8.0	0.0	0.0	0.0	0.0
23, . .	8.0	0.0	+8.0	trace	trace
24, . .	56.0	32.0	0.0	0.0	0.0
25, . .	32.0	24.0	0.0	0.0	trace
26, . .	72.0	40.0	+8.0	+8.0	+8.0
27, . .	48.0	24.0	0.0	0.0	0.0
28, . .	8.0	trace	0.0	0.0	0.0
29, . .	4.0	0.0	0.0	0.0	0.0
30, . .	16.0	8.0	0.0	0.0	0.0
31, . .	40.0	24.0	0.0	0.0	0.0

TABLE V. — *Records showing the Electrical Potential (Volts) taken from an Elm Tree and from Free Air* — Continued.

[Collector III., 12 feet high, in Norway spruce. Nos. IV. and V., readings taken from copper plates in soil. Time of observation, 9 A.M.]

DATE.	Collector I. — Free Air.	Collector II. — Elm.	Collector III. — Spruce.	No. IV. — Small Spruce Tree, not grounded.	No. V. — Small Spruce Tree, grounded.
1904.					
September 1, .	88.0	52.0	+4.0	+4.0	+4.0
2, .	-	-	-	-	-
3, .	-	-	-	-	-
4, .	96.0	56.0	+8.0	+8.0	+8.0
5, .	72.0	40.0	4.0	2.0	4.0
6, .	—8.0	—trace	+0.0	+0.0	+0.0
7, .	40.0	24.0	0.0	0.0	0.0
8, .	56.0	32.0	0.0	0.0	0.0
9, .	72.0	40.0	0.0	trace	trace
10, .	-	-	-	-	-
11, .	-	-	-	-	-
12, .	-	-	-	-	-
13, .	-	-	-	-	-
14, .	-	-	-	-	-
15, .	-	-	-	-	-
16, .	-	-	-	-	-
17, .	-	-	-	-	-
18, .	-	-	-	-	-
19, .	-	-	-	-	-
20, .	-	-	-	-	-
21, .	-	-	-	-	-
22, .	-	-	-	-	-
23, .	-	-	-	-	-
24, .	-	-	-	-	-
25, .	-	-	-	-	-
26, .	0.0	0.0	0.0	0.0	0.0
27, .	8.0	8.0	0.0	0.0	trace
28, .	-	-	-	-	-
29, .	-	-	-	-	-
30, .	24.0	24.0	0.0	trace	trace

September 6, possibly slight movement toward positive in Nos. III., IV. and V.
Operator away from September 10 to September 25.

TABLE V. — *Records showing the Electrical Potential (Volts) taken from an Elm Tree and from Free Air* — Concluded.

[Collector III., 12 feet high, in Norway spruce. Nos. IV. and V., readings taken from copper plates in soil. Time of observation, 9 A.M.]

DATE.	Collector I. — Free Air.	Collector II. — Elm.	Collector III. — Spruce.	No. IV. — Small Spruce Tree, not grounded.	No. V. — Small Spruce Tree, grounded.
1904.					
October 1, . .	40.0	32.0	4.0	2.0	4.0
2, . .	56.0	48.0	4.0	trace	2.0
3, . .	96.0	80.0	8.0	trace	trace
4, . .	-	-	-	-	-
5, . .	8.0	8.0	4.0	4.0	8.0
6, . .	40.0	36.0	trace	trace	trace
7, . .	-	-	-	-	-
8, . .	-	-	-	-	-
9, . .	-	-	-	-	-
10, . .	-	-	-	-	-
11, . .	-	-	-	-	-
12, . .	-	-	-	-	-
13, . .	-	-	-	-	-
14, . .	8.0	8.0	2.0	2.0	4.0
15, . .	40.0	40.0	4.0	trace	4.0
16, . .	8.0	8.0	trace	0.0	0.0
17, . .	16.0	16.0	2.0	trace	2.0
18, . .	40.0	0.0	0.0	0.0	0.0
19, . .	24.0	24.0	trace	0.0	trace
20, . .	-	-	-	-	-
21, . .	-	-	-	-	-
22, . .	-	-	-	-	-
23, . .	-	-	-	-	-
24, . .	40.0	40.0	0.0	0.0	0.0
25, . .	8.0	8.0	trace	trace	trace
26, . .	-	-	-	-	-
27, . .	-	-	-	-	-
28, . .	-	-	-	-	-
29, . .	8.0	8.0	0.0	trace	trace
30, . .	-	-	-	-	-
31, . .	-	-	-	-	-

October 5, leaves turning color, very few falling; October 20, leaves taken off by high wind; October 24, leaves entirely off trees.

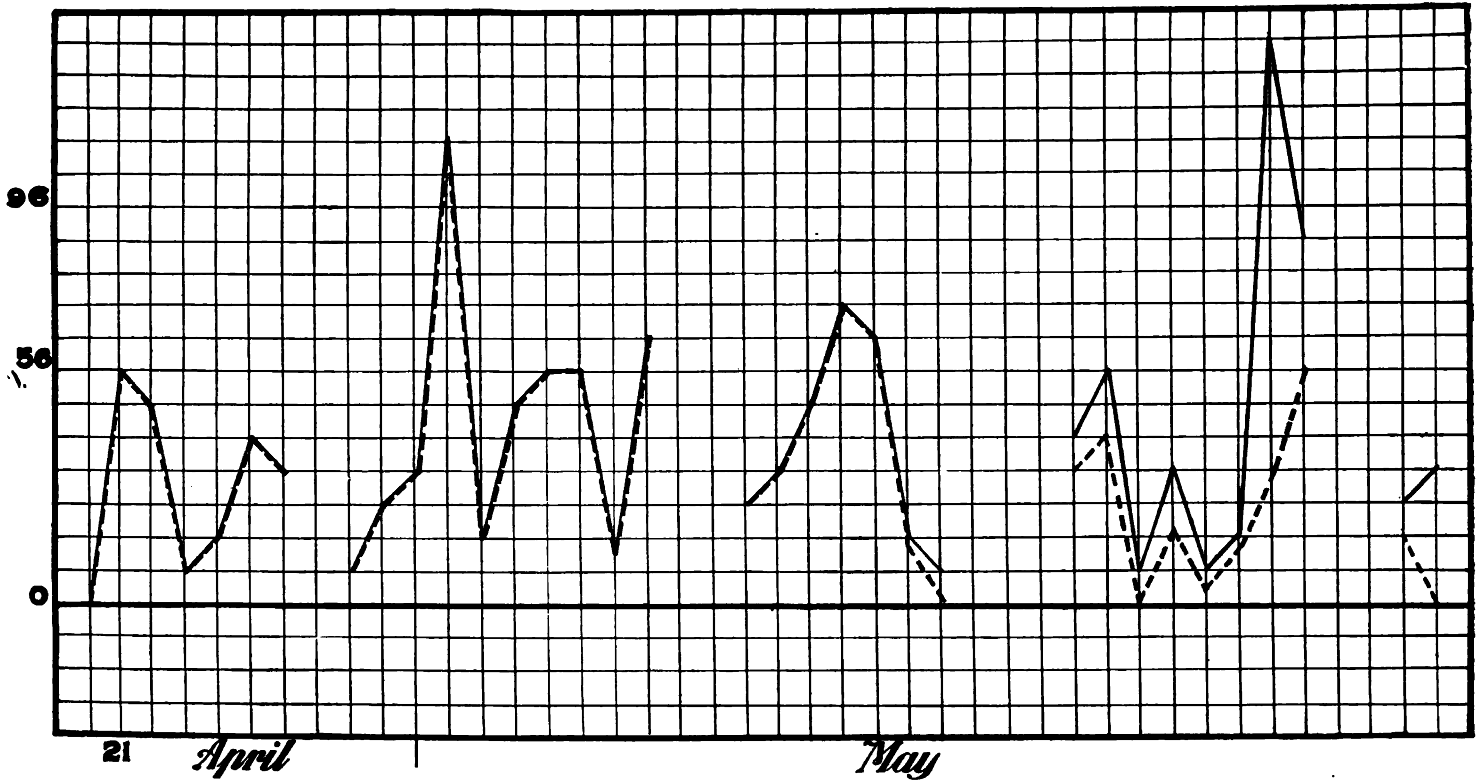

DIAGRAM I. — Showing the results of electrometer readings from free air, Collector I., and elm tree, Collector II., for the months of April and May. The spaces on the abscissa denote days; the spaces on the ordinate denote periods of eight volts each. Solid line indicates free air readings; dotted line indicates elm tree readings.

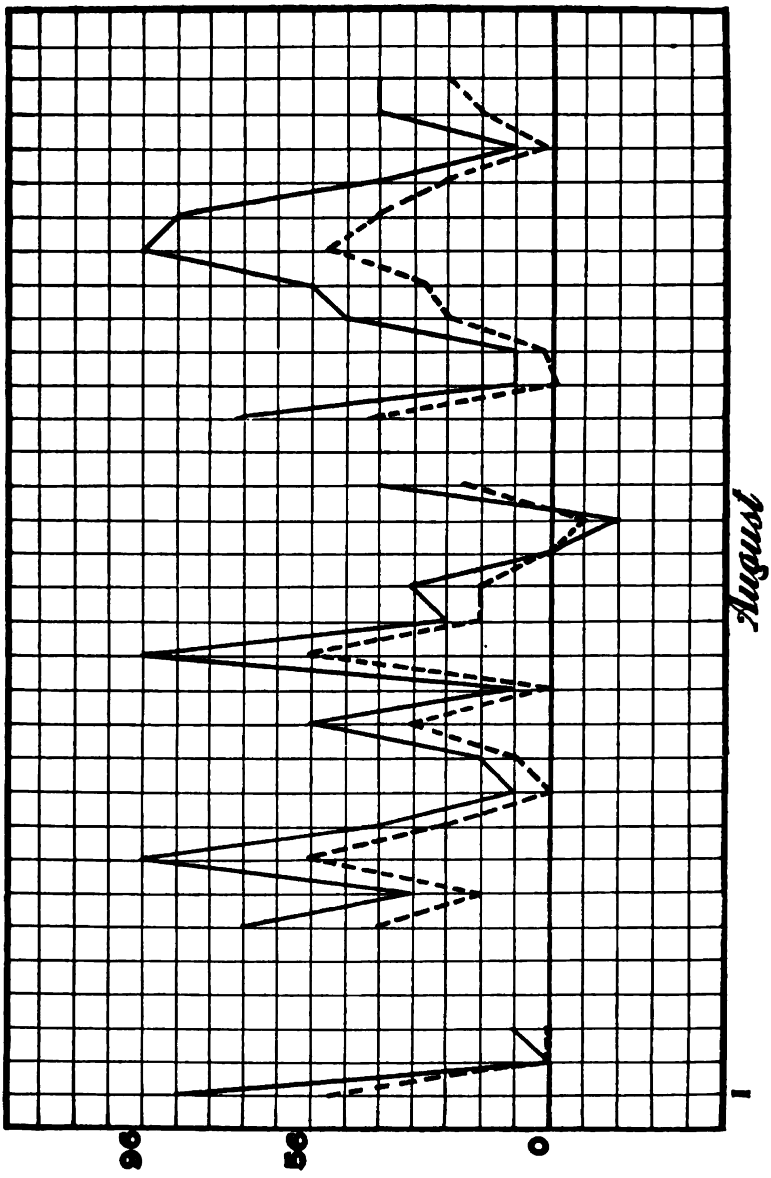

DIAGRAM II.—Showing the results of electrical readings from free air, Collector I., and elm tree, Collector II., for the month of August. The spaces on the aberissa denote days; the spaces on the ordinate denote periods of eight volts each. Solid line indicates free air readings; dotted line indicates elm tree readings.

TABLE VI. — *Summary of Potential Readings of the Preceding Tables, showing the Total and Average Results given by Collector I. (Free Air) and Collector II. (Elm Tree).*

	TOTAL VOLTAGE OF—		AVERAGE DAILY VOLTAGE OF—	
	Collector I. — Free Air.	Collector II. — Elm.	Collector I. — Free Air.	Collector II. — Elm.
April,	240	240	30.0	30.0
May 1 to May 14,	572	572	52.0	52.0
May 14 to May 31,	398	228	44.2	25.3
June,	498	276	38.0	21.2
July,	224	108	37.3	18.0
August,	1,088	592	54.4	29.6
September,	456	276	57.0	34.5
October 1 to October 7,	240	204	48.0	40.8
October 7 to October 31,	152	152	19.0	19.0

While the results obtained from this series of experiments do not possess the same value as the series extending over more than one season, they nevertheless point very strongly to the conclusion that trees do modify to a considerable extent atmospheric electrical potential in their immediate vicinity. By consulting the summary, Table VI., where the total and average potentials for different periods are shown, it will be seen that some important differences occurred between the potentials of the free air and the elm tree collectors. It is significant also that there occurred no difference in the readings between the free air collector and that in the elm tree up to the time when the leaves developed. The few readings which we were able to make in October after the leaves had fallen showed the same results.

Our interpretation of the results of these observations is, that the elm tree took some electricity from the air immediately surrounding it during the period in which it was in foliage. If this single series of observations is typical of what takes place in nature, then we can conclude that the atmospheric electrical potential is not affected much by trees in the immediate vicinity except when they are in foliage. There are a few instances where collectors I. and II. showed positive potentials, and practically the same relative differences are shown here as in the numerous negative potential readings.

The collector in the branches of the spruce tree, 12 feet from the ground (Collector III.), from which it was well insulated, invariably showed the opposite potential from that obtained in the free air and from the elm tree. It will appear from this that the air surrounding the collector in the spruce tree was charged with the same kind of potential (positive or negative) as that of the earth; and the readings taken from Nos. IV. and V., which were very close to this tree, although four feet higher, gave the same kind of potential as that of Collector III., or larger spruce tree. In other words, all the potentials in Nos. III., IV. and V. are opposite to that of the air. There were some difficulties experienced in obtaining readings of the three spruce trees, — partly because the readings had to be taken too close to the ground, and partly, perhaps, because we were dealing with the same kind of potential in the air that the earth was charged with; and that, therefore, when the potential of the air in the branches of the spruce tree and the potential of the earth were the same in degree and kind, differences in potential would not exist, and therefore measurements would be impossible. Evergreen trees, which are supplied with a large number of pointed leaves, may possibly be better adapted to discharge electricity than deciduous trees. It is quite possible that evergreen trees behave quite differently from deciduous trees as regards their relationship to atmospheric electricity. In our opinion, there is a strong probability that all living plants act as conductors, or that they serve to keep the potential of the earth and the air in more or less equilibrium; and that trees and vegetation in general take part in this, although in all probability all species do not act in the same specific manner.

This phase of the subject has not been studied as much as is desirable. We infer from our own observations that some trees show a great tendency towards conducting the electricity from the air to the earth, and that other trees show the same tendency for conducting electricity from the earth to the air; and that in all probability this exchange of electricity from the air to the earth, and *vice versa*, does not take place at the same time through the same tree; and that, under normal conditions, — that is, when no great electrical disturbance is taking place, — some species of trees always conduct the electricity to the air from the earth, while other species conduct electricity from the earth to the air. It is not at all unlikely that in the vicinity of large trees there is exhibited a detrimental influence on crops, and vegetation in general, to an extent which cannot be accounted for by the lack of sunshine and soil moisture.

SOME IMPORTANT LITERATURE RELATING TO DISEASES, ETC., OF CROPS NOT GENERALLY BELIEVED TO BE CAUSED BY FUNGI OR INSECTS.

The publication by Dr. W. C. Sturgis[1] of a host index relating to economic fungi has proved of great value to students, and to those interested in the literature pertaining to fungous diseases of our important cultivated crops. Unfortunately, the host index of Dr. Sturgis does not include those troubles generally termed physiological, or those of an unknown nature.

The following list is compiled to supplement his host index to literature pertaining to fungous diseases. It is by no means complete, but includes at least some of the more important publications of the agricultural experiment stations and United States Department of Agriculture relating to functional and unknown disorders.

APPLE (*Pirus malus*, L.).

Baldwin Fruit-spot, Brown-spot. — N. Y. (Geneva) Agr. Exp. Sta., Bull. No. 164, 1899, pp. 215–219. Vt. Agr. Exp. Sta., Rept. 1899; 1900, pp. 159–164.

Frost-blisters (Leaves). — N. Y. (Geneva) Agr. Exp. Sta., Bull. No. 220, 1902, pp. 217–224. See *Quince.* Mass. Hatch Exp. Sta., Rept. No. 15, 1903, pp. 32–34.

Frost-cracks (Fruit). — Vt. Agr. Exp. Sta., Bull. No. 49, 1895, p. 100. See *Pear.*

Rosette. — Col. Agr. Exp. Sta., Bull. No. 69, 1902, pp. 4–6.

Scald. — Vt. Agr. Exp. Sta., Rept. 1896–97, pp. 55–59; also 11th Rept. 1898, pp. 198, 199.

Spraying and Bloom. — N. Y. (Geneva) Agr. Exp. Sta., Bull. No. 196, 1900.

Spraying Injuries. — N. Y. (Geneva) Agr. Exp. Sta., Bull. No. 220, 1902, pp. 225–230.

APRICOT (*Prunus*).

Leaf-scorch or Sunburn. — Ariz. Agr. Exp. Sta., Rept. 1898, pp. 163–165.

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[1] Conn. (State) Agr. Exp. Sta., Bull. No. 118, 1893; Repts. 17, 1893; 21, 1897; and 24, 1900.

ASTER (*Callistephus hortensis*, Cass.).

Yellows.—Mass. Hatch Exp. Sta., Bull. No. 79, 1902, p. 11.

BEET (*Beta vulgaris*, L.).

Leaf-scorch (*Sugar Beet*).—N. Y. (Geneva) Agr. Exp. Sta., Bull. No. 162, 1899, pp. 167–171.

CAULIFLOWER (*Brassica oleracea*, L.).

Leaf-scorch or Tip-burn.—N. Y. (Geneva) Agr. Exp. Sta., Bull. No. 162, 1899, pp. 176, 177.

CELERY (*Apium graveolens*, L.).

Pithiness.—Maryland Agr. Exp. Sta., Bull. No. 83, 1902; also Bull. No. 93, 1904.

CHERRY (*Prunus Cerasus*, L.).

Leaf-scorch.—N. Y. (Geneva) Agr. Exp. Sta., Bull. No. 162, 1899, pp. 171–176. See *Maple*, etc.

COTTON (*Gossypium*, spp.).

Red Leaf-blight.—Ala. Coll. Sta., Bull. No. 36, 1892, pp. 31, 32.
Shedding of Bolls.—Ala. Coll. Sta., Bull. No. 41, 1892, pp. 50–53.
Yellow Leaf-blight.—Ala. Coll. Sta., Bull. No. 36, 1892, pp. 2–31.

CUCUMBER (*Cucumis sativus*, L.).

Leaf-curl.—Mass. Hatch Exp. Sta., Bull. No. 87, pp. 30, 31.
Stem-curl.—Mass. Hatch Exp. Sta., Bull. No. 87, p. 32.
Wilt.—Mass. Hatch Exp. Sta., Bull. No. 87, p. 32; also Rept. 1899, pp. 159-163.

GRAPE (*Vitis*, spp.).

California Vine Disease.—U. S. Dept. Agr., Div. Veg. Path., Bull. No. 2, 1892. U. S. Dept. Agr., Farmers' Bull. No. 30, pp. 1–11.
Chlorosis.—U. S. Dept. Agr., Div. Veg. Path., Bull. No. 2, 1892, pp. 179–181.
Coulure.—U. S. Dept. Agr., Div. Veg. Path., Farmers' Bull. No. 30, pp. 11–14.
Mal Nero, Rougeot and Folletage.—N. Y. (Cornell Univ.) Agr. Exp. Sta., Bull. No. 76, 1894, pp. 420, 421. U. S. Dept. Agr., Div. Veg. Path., Bull. No. 2, 1892, pp. 181–198.
Sunstroke.—Cal. Agr. Exp. Sta., Rept. 1887–93, pp. 450, 451.
Pourriture.—U. S. Dept. Agr., Div. Veg. Path., Bull. No. 2, 1892, pp. 181, 182.
Shelling.—Conn. (State) Agr. Exp. Sta., Rept. 1896, pp. 278–281. Mich. Agr. Exp. Sta., Bull. No. 121, 1895, p. 51. N. Y. (Cornell Univ.) Agr. Exp. Sta., Bull. No. 76, 1894, pp. 413–440, 452–454.

LETTUCE (*Lactuca sativa*, L.).

Top-burn.—Mass. Hatch Exp. Sta., Bull. No. 69, p. 38; also Rept. 1897, pp. 82–84.

LILY (*Lilium*, spp.).

Bermuda Lily Disease.—U. S. Dept. Agr., Div. Veg. Phys. and Path., Bull. No. 14, 1897.

MELON (*Cucumis Melo*, L.).

Top-burn.—Ga. Agr. Exp. Sta., Bull. No. 57, 1902, p. 190.

ORANGES, LEMONS, ETC. (*Citrus*, spp.).

Blight.—U. S. Dept. Agr., Div. Veg. Phys. and Path., Bull. No. 8, 1896, pp. 9–14. U. S. Dept. Agr., Journ. Mycol., Vol. VII., 1894, pp. 32–34.
Die-back or Exanthema.—Cal. Agr. Exp. Sta., Bull. No. 138, 1902, pp. 40, 41. Fla. Agr. Exp. Sta., Bull. No. 53, 1900, pp. 157–161. U. S. Dept. Agr., Div. Veg. Phys. and Path., Bull. No. 8, 1896, pp. 14–20. U. S. Dept. Agr., Journ. Mycol., Vol. VII., 1894, pp. 29, 30.

Foot-rot or Mal di Gomma. — Fla. Agr. Exp. Sta., Bull. No. 53, 1900, pp. 151-155. U. S. Dept. Agr., Div. Veg. Phys. and Path., Bull. No. 8, 1896, pp. 28-33. U. S. Dept. Agr., Journ. Mycol., Vol. VII., 1894, pp. 30-32.

Melanose. — Fla. Agr. Exp. Sta., Bull. No. 53, 1900, pp. 168, 169. U. S. Dept. Agr., Div. Veg. Phys. and Path., Bull. No. 8, 1896, pp. 33-38.

PEACH (*Prunus Persica*, Benth. and Hook.).

Bordeaux Injury. — Conn. (State) Agr. Exp. Sta., 24th Ann. Rept. 1900, pp. 219-254. N. Y. (Cornell Univ.) Agr. Exp. Sta., Bull. No. 164, 1899, pp. 385-388. See *Plum*. Tenn. Agr. Exp. Sta., Bull., Vol. XV., No. 2, 1902.

Dropsical Swellings of Twigs and Branches. — Ohio Agr. Exp. Sta., Bull. No. 92, 1898, pp. 206-208.

Fruit-crack or Sun-scald. — Col. Agr. Exp. Sta., Bull. No. 41, 1898, pp. 15-18.

Gum Disease. — Mich. Agr. Exp. Sta., Rept. 1896, pp. 123, 124; also Rept. 1897, p. 96. Mich. Agr. Exp. Sta., Bull. No. 156, 1898, p. 304.

Little Peach. — Mich. Agr. Exp. Sta., Rept. 1896. pp. 121, 122; also Bull. No. 156, 1898, pp. 303, 304.

Mechanical Injuries, etc. — Ohio Agr. Exp. Sta., Bull. No. 92, 1898, pp. 189, 190.

Rosette. — Ga. Agr. Exp. Sta., Bull. No. 42, 1898, p. 221. Maryland Agr. Exp. Sta., Bull. No. 42, 1896, pp. 160-162. Oklahoma Agr. Exp. Sta., Bull. No. 20, 1896, p. 21. U. S. Dept. Agr., Div. Veg. Path., Bull. No. 1, 1891. U. S. Dept. Agr., Farmers' Bull. No. 17, pp. 13-17. U. S. Dept. Agr., Journ. Mycol., Vol. VI., pp. 143-148. U. S. Dept. Agr., Journ. Mycol., Vol. VII., 1894, pp. 226-232.

Twig Diseases, — Gum-flow. — Ohio Agr. Exp. Sta., Bull. No. 92, 1898, pp. 199-206.

Twig Spots. — Ohio Agr. Exp. Sta., Bull. No. 92, 1898, p. 208.

Yellows. — Conn. (State) Agr. Exp. Sta., Bull. No. 111, 1892, pp. 7, 8; also Bull. No. 115. Delaware Agr. Exp. Sta., Rept. 1893, pp. 152, 153; also Rept. 1897, pp. 168-173. Ga. Agr. Exp. Sta., Bull. No. 42, 1898, p. 220. Maryland Agr. Exp. Sta., Bull. No. 42, 1896, pp. 157-160. Mass. Bull. Bussey Inst. (Harvard Univ.), Vol. III., Pt. 1, 1901. Mass. Hatch Exp. Sta., Bull. No. 8, 1890, pp. 6-12. Mich. Agr. Exp. Sta., Bull. No. 103, 1894, pp. 46-53. N. J. Agr. Exp. Sta., Rept. 1898, pp. 357-359; also Rept. 1899, pp. 417, 418. N. Y. (Cornell Univ.) Agr. Exp. Sta., Bull. No. 25, 1890, pp. 178-180; also Bull. No. 75, 1894, pp. 392-408. No. Car. Agr. Exp. Sta., Bull. No. 92, 1893, pp. 101, 102, 112; also Bull. No. 120, 1895, pp. 300, 301. Ohio Agr. Exp. Sta., Bull. No. 104, 1899, pp. 212-216; also Bull. No. 92, 1898, pp. 190-199. Pa. Agr. Exp. Sta., Bull. No. 37, 1896, pp. 21-23. U. S. Dept. Agr., Div. Veg. Path., Bull. No. 4, 1893. U. S. Dept. Agr., Div. Veg. Path., Bull. No. 1, 1891. U. S. Dept. Agr., Farmers' Bull. No. 17, 1894. U. S. Dept. Agr., Sec. Veg. Path., Bull. No. 9, 1888. W. Va. Agr. Exp. Sta., Bull. No. 66, 1900, pp. 214, 215.

PEAR (*Pirus communis*, L.).

Frost Injuries. — Col. Agr. Exp. Sta., Bull. No. 41, 1898, pp. 15-18 (tree trunk). See *Plum* and *Peach*. Conn. (State) Agr. Exp. Sta., 19th Rept. 1895, p. 190 (on fruit). Vt. Agr. Exp. Sta., Bull. No. 49, 1895, p. 100 (on fruit). See *Apple*.

PLUM (*Prunus*, spp.).

Frost-cracks and Sun-scald. — Cal. Agr. Exp. Sta., Bull. No. 41, 1898, pp. 15-18. Del. Agr. Exp. Sta., Bull. No. 57, 1902, pp. 13-15.

Gummosis. — Ohio Agr. Exp. Sta., Bull. No. 79, 1897, pp. 121, 122. Oregon Agr. Exp. Sta., Bull. No. 45, 1897, pp. 68-72.

Yellows. — Consult *Peach* literature. Mass. Hatch Exp. Sta., Rept. 1903, p. 35.

POTATO (*Solanum tuberosum*, L.).

Arsenical Poisoning. — Vt. Agr. Exp. Sta., Bull. No. 49, 1895, pp. 97, 98; also Bull. No. 72, 1899, pp. 9, 10.

Internal Brown Rot. — Minn. Agr. Exp. Sta., Bull. No. 39, 1894, pp. 212, 213. Minn. Agr. Exp. Sta., Bull. No. 45, 1895, p. 310. N. Y. (Geneva) Agr. Exp. Sta., Bull. No. 101, pp. 78–83; also Rept. 1896, pp. 504–509.

Pimply Potatoes. — N. Y. (Geneva) Agr. Exp. Sta., Bull. No. 101, 1896, pp. 84, 85; also Rept. 1896, p. 511.

Stem-blight. — N. Y. (Geneva) Agr. Exp. Sta., Bull. No. 101, 1896, pp. 83, 84; also Bull. No. 138, 1897, pp. 632–634.

Sun-scald. — Vt. Agr. Exp. Sta., Bull. No. 72, 1899, pp. 12, 13.

Tip-burn. — U. S. Dept. Agr., Farmers' Bull. No. 91, p. 10. Vt. Agr. Exp. Sta., Bull. No. 49, 1895, pp. 98, 99; also Bull. No. 72, 1899, pp. 10–12.

QUINCE (*Pirus Cydonia*).

Frost-blisters (Leaves). — N. Y. (Geneva) Agr. Exp. Sta., Bull. No. 220, 1902, pp. 224, 225.

RASPBERRY (*Rubus*, spp.).

Yellows. — N. Y. (Geneva) Agr. Exp. Sta., Bull. No. 226, 1902, pp. 362–364.

RICE (*Oryza sativa*, L.).

Blast. — S. C. Agr. Exp. Sta., Bull. No. 41, 1899, pp. 3–7.

ROSE (*Rosa*, spp.).

Bronzing of Leaves. — Mass. Hatch Exp. Sta., Rept. 1899, pp. 156–159. N. J. Agr. Exp. Sta., Rept. 1891, pp. 303, 304.

TOBACCO (*Nicotiana Tabacum*, L.).

Mosaic Disease, "Calico" or Mottled Top. — Conn. (State) Agr. Exp. Sta., Rept. 1898, pp. 242–260; also Rept. 1899, pp. 252–261. U. S. Dept. Agr., Beau. Plant Indus., Bull. No. 18, 1902.

Spotting. — Conn. (State) Agr. Exp. Sta., Rept. 1898, pp. 254–260; also, Rept. 1899, pp. 252–261.

TOMATO (*Lycopersicum esculentum*, Mill.).

Dropping of Buds. — Fla. Agr. Exp. Sta., Bull. No. 21, 1893, pp. 37, 38; also Bull. No. 47, 1898, pp. 148–151.

Hollow Stem. — Fla. Agr. Exp. Sta., Bull. No. 47, 1898, pp. 151–153.

Œdema. — Fla. Agr. Exp. Sta., Bull. No. 47, 1898, pp. 146–148. N. Y. (Cornell Univ.) Agr. Exp. Sta., Bull. No. 53, 1893. Vt. Agr. Exp. Sta., 6th Rept. 1892, p. 88.

MISCELLANEOUS.

Arsenical Injuries. — Cal. Agr. Exp. Sta., Bull. No. 151, 1903.

Lichens, Mosses, etc. — Fla. Agr. Exp. Sta., Bull. No. 53, 1900, pp. 169–173.

Shade Trees. — Mechanical injuries, etc.: Conn. (State) Agr. Exp. Sta., Bull. No. 131, 1900; also 24th Rept. 1900, pp. 330–351. N. Y. (Cornell Univ.) Agr. Exp. Sta., Bull. No. 205, 1902.

Leaf-scorch or wilt: Vt. Agr. Exp. Sta., 13th Rept. 1899–1900, pp. 281, 282. Mass. Hatch Exp. Sta., Rept. 1897, pp. 81, 82. N. Y. (Geneva) Agr. Exp. Sta., Bull. No. 162, 1899, pp. 177, 178.

Illuminating gas, steam, etc.: Mass. Hatch Exp. Sta., Rept. 1899, pp. 163–167.

Loss of foliage: Mass. Hatch Exp. Sta., Rept. 1899, pp. 153, 154.

Current electricity, lightning: Mass. Hatch Exp. Sta., Bull. No. 91, 1903.

Sunstroke: Kentucky Agr. Exp. Sta., Bull. No. 47, 1893, pp. 6–8.

Smoke and Atmospheric Gases. — Pa. State Coll. Publication (Prof. Buckhout), 1900 (effects on trees). Utah Agr. Exp. Sta., Bull. No. 88, 1903 (effects on crops).

REPORT OF THE METEOROLOGIST.

J. E. OSTRANDER.

At the beginning of the year a change was made in the times of observation, from 7 A.M., 2 P.M. and 9 P.M. to 8 A.M. and 8 P.M. This was done in order to make them synchronous with those of the United States Weather Bureau, this station being one of the voluntary stations of that service. This change has made no appreciable difference in the daily means compared with those of previous years, excepting those of relative humidity, where the omission of the observation near midday seems to have resulted in a higher mean. The effect, however, can be more definitely determined after the change has been in operation for a number of years.

As in previous years, much of the work of this division has been that of observation and transcription of the records in permanent form. The usual bulletins have been regularly issued at the beginning of each month, containing the more important daily records, together with the monthly means, and remarks on any unusual features that occurred. An annual summary will be made a part of the December bulletin.

The local forecasts have been regularly received from the Boston office of the United States Weather Bureau, and the signals displayed from the flag-staff on the tower. This station is furnishing the weekly reports for the "snow and ice" bulletin, as has been done the last few years.

In addition to furnishing the section director of the Weather Bureau with the voluntary observers' reports, as well as our printed bulletin, at his request early in the year all the records at this station were examined and the data tabulated to be used in a climatological directory of the principal stations of the United States. A phenological record was also kept during the growing season, and two copies furnished the section director as requested.

As a part of the college exhibit for the Louisiana Purchase Exposition at St. Louis, this division prepared a number of charts in water colors, showing many of the meteorological features of the station. Photographs of most of our self-recording instruments were also sent.

Two new clocks for the Draper instruments were purchased during the year, to replace others that had become unreliable.

Mr. F. F. Henshaw retired as observer upon his graduation in June, and was succeeded by the assistant observer, Mr. G. W. Patch.

REPORT OF THE CHEMIST.

DIVISION OF FOODS AND FEEDING.

J. B. LINDSEY.

Chemical Assistants: E. B. HOLLAND, P. H. SMITH and E. S. FULTON.
Inspector of Feeds and Babcock Machines: ALBERT PARSONS.
Dairy Tester: SUMNER R. PARKER.
In Charge of Feeding Experiments: JOSEPH G. COOK.
Stenographer: MABEL C. SMITH.

PART I. — THE WORK OF THE YEAR.

1. Correspondence.
2. General laboratory work.
3. Character of laboratory work.
   - (*a*) Water.
   - (*b*) Dairy products and cattle feeds.
   - (*c*) Chemical investigations.
4. Inspection of concentrates.
5. Execution of the dairy law.
6. Test of pure-bred cows.
7. Work completed and in progress.
8. Changes in staff.

PART II. — EXPERIMENTS IN ANIMAL NUTRITION.

1. Digestion experiments with sheep.
2. The digestibility of galactan.
3. The feeding value of apple pomace.
4. Blomo feed for horses.

PART I. — THE WORK OF THE YEAR.

J. B. LINDSEY.

1. CORRESPONDENCE.

The general character of the correspondence has been much the same as in former years, and the amount has been approximately 4,000 letters and postals, in addition to some 1,000 circulars relative to adulterated mixed feeds.

2. GENERAL LABORATORY WORK.

The work in the laboratory has been of the same character as formerly. The number of determinations of butter fat in milk has greatly increased.

There have been sent in for examination 104 samples of water, 773 of milk, 1,779 of cream, 2 of butter and 153 of feed stuffs. In connection with experiments by this and other divisions of the station, there have been analyzed, in whole or in part, 234 samples of milk and cream and 530 of fodders and feed stuffs. There have also been collected and tested under the provision of the feed law 686 samples of concentrated feed stuffs. This makes a total of 4,261 substances analyzed during the year, as against 3,897 last year and 3,240 in the previous year. Work on the availability of organic nitrogen, not included in the above, has been done for the Association of Official Agricultural Chemists. In addition, 20 candidates have been examined and given certificates to operate Babcock machines, and 2,026 pieces of glassware have been tested for accuracy, of which 200 pieces, or 9.87 per cent., were condemned.

3. CHARACTER OF LABORATORY WORK.

(a) *Water.*

In accordance with instructions from the experiment station committee, this department continues to charge the sum of $3 for a sanitary analysis of water. The number of samples examined has been 104, which is considerably less than when the work was done free of cost. It is believed that this charge has held in check those who have heretofore abused the privilege by sending in a large number of samples, in some cases out of mere curiosity.

Instructions for securing an analysis of water: —

> Those wishing to secure a sanitary analysis of water must first make application, whereupon a glass bottle securely encased, accompanied by full instructions for collecting and shipping the sample, will be forwarded by express. The return express must in all cases be prepaid. Because of the smallness of the sum involved, no account will be opened. Remittance by check, P. O. money order, or money at the owner's risk, must be strictly in advance.
>
> Address Dr. J. B. Lindsey,
> *Hatch Experiment Station, Amherst, Mass.*

(*b*) *Dairy Products and Cattle Feeds.*

The station received about the usual number of samples of milk and cream. Many samples are sent by farmers to ascertain the quality of milk produced by their herd or by individual cows, and this should meet with every encouragement. Printed circulars are sent in answer to inquiries, giving concise information concerning the quality of milk produced by different breeds, as well as full instructions relative to the best methods of determining the productive capacity of the dairy herd. The station also tests a large number of samples of milk and cream for creameries at a charge sufficient to cover the cost.

About the usual number of feed stuffs were received during the year. These come from practical feeders, who either suspect adulteration, or desire to know the value of a feed new to their locality. The results of the examination are returned promptly, together with such information as is suited to the particular case. A considerable number of samples are also received from feed dealers, who wish to make sure as to the intrinsic value of the materials they are offering. It is believed that this desire for information should be encouraged as much as the limited resources of the department permit.

(c) *Chemical Investigations.*

In so far as time and opportunity permit, the department aims to make a study of chemical methods that will facilitate the accurate and rapid determinations of the different substances connected with animal or plant life. In this study of methods the department co-operates yearly with the Association of Official Agricultural Chemists.

4. INSPECTION OF CONCENTRATES.

The passage of the feed law by the Legislature of 1903 makes it possible to give the attention to this line of work which its importance demands. A regular inspector is now employed, who travels through the State from six to eight months in the year, so that the station is kept well informed regarding the variety and character of the feeds offered for sale. The results of the several inspections were published in Bulletins Nos. 93 and 98, issued in January and August. These bulletins contained 52 and 36 pages respectively. It may be said that the major portion of the feeds now offered are properly branded and free from adulteration; still, some manufacturers and local dealers continue to be careless about attaching the proper form of guarantee, and, while the station has not prosecuted any cases as yet, there will be no hesitation in doing so if occasion makes it necessary.

A tendency is noted on the part of both manufacturers and dealers to mix more or less oat offal or other filler with standard by-products, thus reducing the cost of the article sufficiently to enable them to slightly undersell their competitors. The station is taking a firm stand against such deceptions.

During the present autumn a considerable quantity of wheat mixed feed, bran and middlings, was found considerably adulterated with ground corn cobs and wheat screenings. The prompt attention of the jobbers was called to the matter, and they took steps immediately to attach the proper guarantee. A special circular relative to this fraud was sent to all the principal grain dealers in the State, as well as to the agricultural press.

It is not necessary to make a chemical analysis of as many samples as formerly. More attention is being given to the work of careful inspection and to the collecting of those samples which are suspected of being below standard or adulterated. The correspondence in connection with this police work, as it may be termed, requires a great deal of time and patience. It is believed that all farmers and dairymen can now keep themselves well posted upon the character and value of the large variety of feeds offered, if they are disposed to do so. Interested parties are referred to the various feed bulletins for details. Bulletin No. 101, comprising the results of the autumn inspection, is now in press, and will be issued during the present month (December).

5. Execution of the Dairy Law.

The enforcement of this law has been given the same careful attention as in previous years.

Inspection of Glassware. — All glassware found to be correctly graduated has been marked "Mass Ex St." There were 2,026 pieces examined, of which 200, or 9.87 per cent., were condemned. Inaccurate graduation of bottles has been rather more noticeable of late than at any time since the early days of the inspection. This is to be regretted, and it is hoped the manufacturers will take immediate action to prevent a possible recurrence. Bulb cream bottles (Bartlett) have been previously passed on accuracy of total graduation, as the usual charge of 5 cents apiece would not permit of additional testing. The continued use of these bottles by some of the prominent milk depots has rendered it necessary to test the three distinct portions of the scale, at a corresponding increase in cost.

Examination of Candidates. — A few more candidates than usual were examined, and 20 certificates of competency issued. A considerable number showed very poor manipulation, and lacked a thorough understanding of the method. In case of failure, applicants are obliged to wait a month before a second examination will be given.

Inspection of Babcock Machines. — The inspection of machines the present year has been in charge of Mr. Albert Parsons, who makes the following report: —

The annual inspection of Babcock machines was made in November of 1904. Fifty-six establishments were either visited or heard from, 36 being creameries and 20 milk depots. Twenty-one, or one-third the number, are co-operative, while the other 35 are proprietary, or managed by stock companies. Thirty-six machines were inspected. The number is 4 less than last year, due to the fact that 2 creameries and 1 milk depot have been discontinued, and 1 milk depot does not use its tester. Some machines overheated the tests, and a few required additional steam to warm them. One needed slight repairs of the steam gauge, but the others were in satisfactory condition, and in general showed an improvement over last year. Steam was the motive power in every case except one, where electricity was used. All but 5 of the machines have frames of cast iron, which is taking the place of galvanized iron and copper. Of the cast-iron machines, 19 are "Facile," 10 "Agos," and 2 "Wizard." The last named has only recently been placed upon the market. As a rule, the glassware was found in good condition, although in a few cases it was very dirty. In addition to the regular inspection, two city milk inspectors were visited. Each had a "Wizard" cast-iron machine, one being run by electricity and the other by a water motor. The electrical machine did not have sufficient power for the necessary speed. The other was in good condition, and a certificate was given.

6. Tests of Pure-bred Cows.

This work has increased to such an extent as to render necessary the employment of a regular tester, Mr. Sumner R. Parker of the class of 1904 of this college, who gives it his whole time. The testing is conducted under the supervision of the American Guernsey and Jersey cattle clubs and the Holstein-Friesian Association. The work consists largely in determining the yearly milk and butter fat yields of pure-bred cows of the several breeds. The inspector visits the farms monthly, weighs the milk for one or two days, determines the butter fat by the Babcock method, and reports his findings to the secretary of the respective clubs, together with such other data, relative to feed, scattered milkings, etc., as are required. These tests are known as "yearly milk and butter fat tests," or "authenticated butter fat estimate and milk record." There are at present

51 Guernsey and Jersey cows under test, belonging to F. Lothrop Ames of North Easton, N. I. Bowditch of Framingham, W. L. Cutting of Pittsfield, R. F. and A. H. Parker of Westborough, A. H. Sagendorph of Spencer, C. I. Hood of Lowell, A. F. Pierce of Winchester, N. H., and R. A. Sibley of Spencer.

In addition, seven-day butter tests are occasionally called for by the Jersey Cattle Club, in which case it becomes necessary to weigh, sample and test not only the milk but the skim milk, buttermilk and butter; and the total fat in the three latter, together with that in the test samples, should balance the fat in the original milk, with the exception of small mechanical losses. The butter is analyzed at the station laboratory. Seven-day tests are also made for the Holstein-Friesian Association, which simply calls for the amount of milk and butter fat produced by the animal during that period.

7. Work completed and in Progress.

In addition to Bulletins Nos. 93 and 98, devoted to the inspection of feeding stuffs, this department has published during the year Bulletin No. 94, on distillery and brewery by-products, and Bulletin No. 99, on dried molasses beet pulp, and nutrition of horses. An experiment has been completed on the use of dried blood as a source of protein for milk production, showing that digestible protein in this material is equal in feeding value to a similar amount in cotton-seed meal. An experiment has also been completed with Pratts food as an aid to milk production. The results make clear that the claims put forward by the manufacturers relative to the wonderful influence of this food in increasing the quantity and quality of milk are entirely without foundation. Bibby's dairy cake has also been compared with gluten feed for the production of milk, and, while the results are not yet entirely tabulated, it is quite evident that the Bibby cake possesses no particular merits over other feed stuffs of a similar composition, and that the price asked is out of proportion to its actual feeding value. A number of experiments have been in progress with green forage crops, but, as the results at present are only of a tentative character, they will not be published until it is possible to deduce more definite conclusions.

Some 34 tons of corn and soy beans were grown together the past season on a little less than 3 acres of land, and the fodder ensiled. The silo has been recently opened, the silage appears in good condition and is readily eaten. It was not found possible to cut this mixture satisfactorily with a corn harvester, and the writer is forced to the conclusion that, until this can be accomplished, it will be doubtful economy to attempt to grow it to any extent for silage purposes. It is believed that the value of the extra protein obtained is more than offset by the increased cost of harvesting the crop.

Experiments are in progress relative to the value of molasses and molasses feeds as food for dairy stock and horses, and will occupy a considerable portion of the winter months. Attention is called to the several completed experiments published in Part II. of this report.

8. Changes in Staff.

Mr. W. E. Tottingham, employed in this department as assistant chemist for a year, resigned September 1 to continue his studies in the chemical department of the college. His work was very satisfactory. Mr. E. S. Fulton of the class of 1904 of the college succeeded Mr. Tottingham. Mr. S. R. Parker, another graduate of the class of 1904, began his duties August 1 as dairy tester. He is kept constantly employed in this line of work.

PART II. — EXPERIMENTS IN ANIMAL NUTRITION.

1. DIGESTION EXPERIMENTS WITH SHEEP.

J. B. LINDSEY.[1]

This station has given considerable time and study to the digestibility of coarse and concentrated cattle feeds. The first experiments were made in the autumn and winter of 1892–93, and the results published, together with a description of the method employed, in the eleventh report of the Massachusetts State Experiment Station. The results of further experiments were published in the twelfth report. A summary of all experiments made between 1894 and 1902 will be found in the fifteenth report of the Hatch Experiment Station, pp. 82–101. Experiments made during 1902 appeared in the sixteenth report of this station.

The experiments here described were made during the autumn of 1903 and winter and spring of 1904. The full data are here presented, with the exception of the daily production of manure and the daily water consumption, in which cases, to economize space, only averages are presented.

The period extended over fourteen days, the first seven of which were preliminary, collection of fæces being made during the last seven. Ten grams of salt were fed each sheep daily, in addition to the regular ration. Water was before the animals at all times.

Two lots of sheep, grade Southdown wethers, were employed in the several trials, known as the old and the young sheep. The former were five to six years of age, and had been used by the station for a number of years; the latter were dropped in 1902, and were employed for the first time during the autumn and winter of 1903–04.

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[1] With E. B. Holland, P. H. Smith, W E. Tottingham and J. G. Cook.

The digestion coefficients for the digestion hay, used in calculating the results of the several experiments with the old sheep, were those obtained with Sheep II. and III., Sheep I. having been disposed of before the digestibility of the hay was determined.

The individual coefficients were used for the young sheep, being obtained from the average of the two trials in the case of Sheep I. and II., and that of the single trial for Sheep III.

Hay Coefficients used (Per Cent.).

	Old Sheep.	Young Sheep.		
		I.	II.	III.
Dry matter,	58.50	49.89	54.34	51.58
Ash,	22.00	13.86	22.60	16.55
Protein,	42.50	37.37	37.72	36.66
Fiber,	61.00	49.96	55.85	53.13
Extract matter,	64.00	56.29	59.77	57.02
Fat,	46.50	38.54	44.19	36.97

In calculating the digestion coefficients when English hay was used, excepting in periods IV., V. and XII., the average analysis of the two samples of hay was employed.

Composition of Feed Stuffs (Per Cent.).

[Dry matter.]

Feeds.	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
Soy bean fodder,	11.82	20.03	22.12	42.55	3.48
Waste soy bean fodder, Sheep II.,	8.64	4.85	55.47	30.83	.71
Eureka silage corn fodder,	6.19	9.34	27.41	55.52	1.54
Apple pomace,	3.05	5.13	16.10	69.32	6.40
Cotton-seed meal fed with pomace,	6.95	52.16	5.88	25.91	9.10
English hay fed to new sheep,	6.53	6.23	33.00	52.27	1.97
Waste English hay,[1] Sheep III., fine hay and seeds.	29.19	6.76	21.67	40.25	2.13
English hay fed to old sheep,	6.35	6.24	31.95	53.15	2.31
Bibby's dairy cake,	9.14	23.52	9.28	48.06	10.00
Bibby's dairy cake (1903),	8.38	21.39	9.19	50.42	10.62
Alma dried molasses-beet-pulp,	5.64	9.87	17.17	66.74	.58

[1] Contained 21.39 per cent. of salt.

Composition of Feed Stuffs (Per Cent.) — Concluded.

[Dry matter.]

FEEDS.	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
Armour's blood meal,	3.37	95.24	.88	-	.51
Corn meal fed with blood meal,	1.41	9.87	2.09	82.25	4.38
Soy bean meal, coarse ground,	5.73	40.69	4.71	27.77	21.10
Hominy feed,	3.15	11.66	5.46	70.11	9.62
Hominy meal (1903),	3.38	12.23	4.97	69.43	9.99
Eureka silage corn fodder (dry),	7.85	9.82	32.70	47.90	1.73
Waste corn stover, Sheep II.,	9.85	9.16	34.13	45.07	1.79
English hay,[1]	6.46	6.74	32.28	52.16	2.36
Waste English hay, Sheep I.,	6.94	6.17	32.72	52.05	2.12
Waste English hay,[2] Sheep II.,	14.90	6.95	27.41	48.23	2.43

[1] Used in Period XII.

[2] Contained 7.38 per cent. of salt.

Composition of Fæces (Per Cent.).

[Dry matter.]

Old Sheep I.

Period.	FEEDS.	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
I.,	Soy bean fodder,	18.55	8.62	33.83	35.99	3.01
II.,	Eureka silage corn fodder,	9.87	8.77	33.67	46.28	1.41
III.,	Apple pomace,	9.93	18.53	24.38	40.21	6.95
XXVI. (1903),	Bibby's dairy cake,	12.88	14.93	27.19	41.62	3.38
XXVIII. (1903),	Hominy meal,	11.31	13.41	28.49	43.33	3.46

Old Sheep II.

Period.	FEEDS.	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
I.,	Soy bean fodder,	19.95	9.44	33.48	34.05	3.08
II.,	Eureka silage corn fodder,	11.47	9.85	31.70	45.30	1.68
III.,	Apple pomace,	9.93	17.97	23.24	41.07	7.79
V.,	English hay,	11.78	8.42	30.93	46.03	2.84
VII.,	Alma dried molasses-beet-pulp,	12.37	10.80	29.21	44.15	3.47
IX.,	Soy bean meal,	12.87	9.82	29.50	44.64	3.17
XI.,	Eureka silage corn fodder (dry),	12.73	11.58	26.04	47.87	1.78
XXVI. (1903),	Bibby's dairy cake,	13.89	14.86	26.54	41.23	3.48
XXVIII. (1903),	Hominy meal,	12.91	14.22	25.99	43.21	3.67

Composition of Fæces (Per Cent.) — Concluded.

[Dry matter.]

Old Sheep III.

Period.	FEEDS.	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
I., . .	Soy bean fodder, ...	19.96	9.34	32.18	35.34	3.18
II., . .	Eureka silage corn fodder, . .	10.92	9.14	32.41	45.89	1.64
III., . .	Apple pomace, ...	11.44	20.82	19.82	40.40	7.52
V., . .	English hay, ...	12.15	9.01	29.49	46.18	3.17
VII., . .	Alma dried molasses-beet-pulp, .	12.51	11.21	27.82	45.04	3.42
IX., . .	Soy bean meal, ...	12.02	10.67	26.56	46.96	3.79
XI., . .	Eureka silage corn fodder (dry), .	12.79	11.84	25.27	48.29	1.81
XXVI. (1903),	Bibby's dairy cake, ...	13.93	15.59	24.63	41.87	3.98
XXVIII. (1903),	Hominy meal, ...	13.06	14.88	24.06	43.41	4.59

Young Sheep I.

Period.	FEEDS.	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
IV., . . .	English hay, ...	11.16	7.86	32.51	45.75	2.72
VI., ...	Bibby's dairy cake, ...	12.62	11.19	30.20	43.41	2.58
VIII., . . .	Armour's blood meal, . . .	10.64	13.03	31.49	42.29	2.55
X., . . .	Marshall's hominy feed, . .	10.98	10.81	29.89	45.47	2.85
XII., . . .	English hay, ...	11.12	8.38	32.64	45.34	2.52

Young Sheep II.

Period.	FEEDS.	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
IV., . . .	English hay, ...	10.70	8.40	31.51	46.74	2.65
VI., . . .	Bibby's dairy cake, ...	12.03	12.50	30.29	42.61	2.57
VIII., . . .	Armour's blood meal, . . .	10.47	15.57	29.30	42.23	2.43
X., . . .	Marshall's hominy feed, . .	10.72	11.30	30.08	45.36	2.54
XII., . . .	English hay, ...	11.21	9.26	31.72	45.24	2.57

Young Sheep III.

Period.	FEEDS.	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
IV., . . .	English hay, ...	10.92	7.97	32.20	46.40	2.51
VI., . . .	Bibby's dairy cake, ...	12.90	11.08	31.30	42.36	2.36
X., . . .	Marshall's hominy feed, . .	10.62	9.97	30.60	46.14	2.67

Dry Matter Determinations made at Time of Weighing out the Different Foods, and Dry Matter in Manure excreted, determined from Air-dry Fæces (Per Cent.).

Old Sheep I.

PERIODS.	English Hay.	Soy Bean Fodder.	Eureka Silage Corn Fodder.	Apple Pomace.	Cotton-seed Meal.	Alma Dried Molasses-beet-pulp.	Soy Bean Meal.	Eureka Silage Corn Fodder (Dry).	Bibby's Dairy Cake.	Hominy Meal.	Waste.	Manure.
I., . .	87.27	23.94	-	-	-	-	-	-	-	-	-	91.02
II., . .	-	-	17.42	-	-	-	-	-	-	-	-	89.82
III., . .	87.05	-	-	19.83	89.34	-	-	-	-	-	-	92.23
XXVI. (1903),	88.82	-	-	-	-	-	-	-	89.80	-	-	92.43
XXVIII. (1903),	88.25	-	-	-	-	-	-	-	-	88.48	-	92.98

Old Sheep II.

PERIODS.	English Hay.	Soy Bean Fodder.	Eureka Silage Corn Fodder.	Apple Pomace.	Cotton-seed Meal.	Alma Dried Molasses-beet-pulp.	Soy Bean Meal.	Eureka Silage Corn Fodder (Dry).	Bibby's Dairy Cake.	Hominy Meal.	Waste.	Manure.
I., . .	87.27	23.94	-	-	-	-	-	-	-	-	96.37	90.82
II., . .	-	-	17.42	-	-	-	-	-	-	-	-	89.98
III., . .	87.05	-	-	19.83	89.34	-	-	-	-	-	-	92.00
V., . .	88.10	-	-	-	-	-	-	-	-	-	-	92.50
VII., . .	87.82	-	-	-	-	92.62	-	-	-	-	-	93.55
IX., . .	88.37	-	-	-	-	-	86.96	-	-	-	-	94.42
XI., . .	-	-	-	-	-	-	-	40.08	-	-	51.19	93.84
XXVI. (1903),	88.82	-	-	-	-	-	-	-	89.80	-	-	92.66
XXVIII. (1903),	88.25	-	-	-	-	-	-	-	-	88.48	-	92.54

Old Sheep III.

PERIODS.	English Hay.	Soy Bean Fodder.	Eureka Silage Corn Fodder.	Apple Pomace.	Cotton-seed Meal.	Alma Dried Molasses-beet-pulp.	Soy Bean Meal.	Eureka Silage Corn Fodder (Dry).	Bibby's Dairy Cake.	Hominy Meal.	Waste.	Manure.
I., . .	87.27	23.94	-	-	-	-	-	-	-	-	-	90.77
II., . .	-	-	17.42	-	-	-	-	-	-	-	-	89.81
III., . .	87.05	-	-	19.83	89.34	-	-	-	-	-	-	91.88
V., . .	88.10	-	-	-	-	-	-	-	-	-	-	92.56
VII., . .	87.82	-	-	-	-	92.62	-	-	-	-	-	93.60
IX., . .	88.37	-	-	-	-	-	86.96	-	-	-	-	94.61
XI., . .	-	-	-	-	-	-	-	40.08	-	-	-	93.84
XXVI. (1903),	88.82	-	-	-	-	-	-	-	89.80	-	-	92.84
XXVIII. (1903),	88.25	-	-	-	-	-	-	-	-	88.48	-	92.91

Dry Matter Determinations, etc. — Concluded.

Young Sheep I.

PERIODS.	English Hay.	Bibby's Dairy Cake.	Armour's Blood Meal.	Corn Meal.	Marshall's Hominy Feed.	Waste.	Manure.
IV., . .	87.90	-	-	-	-	86.65	93.36
VI., . .	88.05	89.45	-	-	-	-	93.78
VIII., . .	87.85	-	88.70	86.13	-	-	93.45
X., . .	89.30	-	-	-	88.53	-	94.06
XII., . .	89.77	-	-	-	-	87.00	93.22

Young Sheep II.

PERIODS.	English Hay.	Bibby's Dairy Cake.	Armour's Blood Meal.	Corn Meal.	Marshall's Hominy Feed.	Waste.	Manure.
IV., . .	87.90	-	-	-	-	-	93.27
VI., . .	88.05	89.45	-	-	-	-	93.55
VIII., . .	87.85	-	88.70	86.13	-	-	93.33
X., . .	89.30	-	-	-	88.53	-	93.78
XII., . .	89.77	-	-	-	-	87.80	92.84

Young Sheep III.

PERIODS.	English Hay.	Bibby's Dairy Cake.	Armour's Blood Meal.	Corn Meal.	Marshall's Hominy Feed.	Waste.	Manure.
IV., . .	87.90	-	-	-	-	86.50	93.25
VI., . .	88.05	89.45	-	-	-	-	94.16
X., . .	89.30	-	-	-	88.53	87.80	94.08

Average Daily Amount of Manure excreted and Water drank (Grams).

Period.	CHARACTER OF RATION.	OLD SHEEP I.			OLD SHEEP II.			OLD SHEEP III.		
		Manure excreted daily.	Sample Air Dry.	Water drank daily.	Manure excreted daily.	Sample Air Dry.	Water drank daily.	Manure excreted daily.	Sample Air Dry.	Water drank daily.
I., . .	Soy bean fodder, ...	699	35.09	1,409	684	34.26	1,492	679	34.67	1,296
II., . .	Eureka silage corn fodder, ...	630	23.53	-	506	20.70	-	481	21.77	-
III., . .	Apple pomace, ...	669	27.29	536	581	24.68	414	818	25.95	-
V., . .	English hay, ...	-	-	-	806	36.94	1,067	717	33.92	1,391
VII., . .	Alma dried molasses-beet-pulp, ...	-	-	-	613	27.13	1,379	623	28.69	1,386
IX., . .	Soy bean meal, ...	-	-	-	736	27.48	1,264	860	30.62	1,638
XI., . .	Eureka silage corn fodder (dry), ...	-	-	-	400	16.61	516	506	18.55	1,006
XXVI. (1903), .	Bibby's dairy cake, ...	923	31.86	2,370	703	27.13	1,688	784	30.68	1,992
XXVIII. (1903), .	Hominy meal, ...	700	28.73	2,500	825	26.25	2,017	637	23.14	2,196

Average Daily Amount of Manure excreted, etc. — Concluded.

Period.	CHARACTER OF RATION.	YOUNG SHEEP I.			YOUNG SHEEP II.			YOUNG SHEEP III.		
		Manure excreted daily.	Sample Air Dry.	Water drank daily.	Manure excreted daily.	Sample Air Dry.	Water drank daily.	Manure excreted daily.	Sample Air Dry.	Water drank daily.
IV., ...	English hay, ...	979	39.76	1,309	881	37.47	2,477	875	36.80	1,827
VI., ...	Bibby's dairy cake, ...	956	32.47	1,368	881	32.52	2,156	915	32.99	2,104
VIII., ...	Armour's blood meal, ...	628	27.88	1,369	628	27.72	2,266	-	-	-
X., ...	Marshall's hominy feed, ...	837	29.40	1,339	912	29.16	1,894	844	30.87	2,076
XII., ...	English hay, ...	994	35.08	1,354	799	33.20	2,467	-	-	-

Weights of Animals at Beginning and End of Period (Pounds).

Period.	CHARACTER OF RATION.	OLD SHEEP I.		OLD SHEEP II.		OLD SHEEP III.	
		Beginning.	End.	Beginning.	End.	Beginning.	End.
I.,	Soy bean fodder,	167.25	168.00	154.50	155.25	152.75	149.50
II.,	Eureka silage corn fodder,	167.50	164.75	156.00	154.50	149.00	145.75
III.,	Apple pomace,	170.75	171.50	157.50	158.25	152.75	153.50
V.,	English hay,	-	-	164.00	162.00	159.50	160.00
VII.,	Alma dried molasses-beet-pulp,	-	-	162.00	162.75	160.50	160.25
IX.,	Soy bean meal,	-	-	163.00	163.25	161.00	158.25
XI.,	Eureka silage corn fodder (dry),	-	-	159.75	157.00	153.75	153.50
XXVI. (1903),	Bibby's dairy cake,	159.00	154.75	155.00	154.25	149.00	146.75
XXVIII. (1908),	Hominy meal,	156.75	152.00	157.25	156.50	150.25	149.00

Weights of Animals, etc. — Concluded.

Period.	CHARACTER OF RATION.	YOUNG SHEEP I.		YOUNG SHEEP II.		YOUNG SHEEP III.	
		Beginning.	End.	Beginning.	End.	Beginning.	End.
IV.,	English hay,	98.50	95.00	97.00	98.25	97.00	96.00
VI.,	Bibby's dairy cake,	95.25	93.00	98.75	92.25	90.25	90.75
VIII.,	Armour's blood meal,	96.25	97.50	91.25	93.50	-	-
X.,	Marshall's hominy feed,	94.00	94.50	88.00	90.25	89.00	89.25
XII.,	English hay,	98.75	96.50	91.50	94.25	-	-

Period I.

Old Sheep I.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
400 grams English hay,	349.08	22.48	21.78	113.38	183.97	7.47
2,000 grams soy bean fodder,	478.80	56.59	95.90	105.91	203.73	16.66
Amount consumed,	827.88	79.07	117.68	219.29	387.70	24.13
850.87 grams manure excreted,	319.36	59.24	27.53	108.04	114.94	9.61
Grams digested,	508.52	19.83	90.15	111.25	272.76	14.52
Minus hay digested,	204.21	4.95	9.26	69.16	117.74	3.47
Soy bean fodder digested,	304.31	14.88	80.89	42.09	155.02	11.05
Per cent. digested,	63.56	26.29	84.35	39.74	76.09	66.33

Old Sheep II.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
2,000 grams soy bean fodder fed,	478.80	56.59	95.90	105.91	203.73	16.66
Minus 36 grams waste,	34.69	3.00	1.69	19.24	10.52	.25
Soy bean fodder consumed,	444.11	53.59	94.22	86.67	193.21	16.41
400 grams English hay,	349.08	22.48	21.78	113.38	183.97	7.47
Amount consumed,	773.19	76.07	116.00	200.05	377.18	23.88
342.59 grams manure excreted,	311.14	62.07	29.37	104.17	105.94	9.58
Grams digested,	482.05	14.00	86.63	95.88	271.24	14.30
Minus hay digested,	204.21	4.95	9.26	69.16	117.74	3.47
Soy bean digested,	277.84	9.05	77.37	26.72	153.50	10.83
Per cent. digested,	62.51	16.89	82.12	30.83	79.45	66.00

Old Sheep III.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Amount consumed same as for Sheep I.,	827.88	79.07	117.68	219.29	387.70	24.13
346.71 grams manure excreted,	314.71	62.82	29.39	101.27	111.22	10.01
Grams digested,	513.17	16.25	88.29	118.02	276.48	14.12
Minus hay digested,	204.21	4.95	9.26	69.16	117.74	3.47
Soy bean fodder digested,	308.96	11.30	79.03	48.86	158.74	10.65
Per cent. digested,	64.53	19.97	82.41	46.13	77.92	63.93
Average per cent. three sheep digested,	63.53	21.05	82.96	38.90	77.82	65.42

Period II.

Old Sheep I.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
3,400 grams Eureka silage corn, ...	592.28	36.66	55.32	162.34	328.83	9.12
235.29 grams manure excreted, ...	211.34	20.86	18.53	71.16	97.81	2.98
Grams digested, ...	380.94	15.80	36.79	91.18	231.02	6.14
Per cent. digested, ...	64.32	43.10	66.50	56.17	70.26	67.32

Old Sheep II.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
3,400 grams Eureka silage corn, ...	592.28	36.66	55.32	162.34	328.83	9.12
207.01 grams manure excreted, ...	186.16	21.35	18.34	59.01	84.33	3.13
Grams digested, ...	406.12	15.31	36.98	103.33	244.50	5.99
Per cent. digested, ...	68.57	41.76	66.85	63.65	74.35	65.68

Old Sheep III.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
3,400 grams Eureka silage corn, ...	592.28	36.66	55.32	162.34	328.83	9.12
217.69 grams manure excreted, ...	195.51	21.35	17.87	63.36	89.72	3.21
Grams digested, ...	396.77	15.31	37.45	98.98	239.11	5.91
Per cent. digested, ...	66.99	41.76	67.70	60.97	72.72	64.80
Average per cent. three sheep digested, . .	66.63	42.21	67.02	60.26	72.44	65.93

Period III.

Old Sheep I.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
250 grams English hay, ...	217.63	14.02	13.58	70.69	114.69	4.66
150 grams cotton-seed meal, ...	134.01	9.31	69.90	7.88	34.72	12.19
2,000 grams apple pomace, ...	396.60	12.10	20.35	63.85	274.92	25.38
Amount consumed, ...	748.24	35.43	103.83	142.42	424.33	42.23
272.89 grams manure excreted, ...	251.82	25.01	46.66	61.39	101.26	17.50
Grams digested, ...	496.42	10.42	57.17	81.03	323.07	24.73
Minus hay digested, ...	127.31	3.08	5.77	43.12	73.40	2.17
	369.11	7.34	51.40	37.91	249.67	22.56
Minus cotton-seed meal digested, ...	101.85	2.23	61.51	2.52	22.22	11.34
Apple pomace digested, ...	267.26	5.11	-	35.39	227.45	11.22
Per cent. digested, ...	67.39	42.23	-	55.43	82.73	44.21

Old Sheep II.

Amount consumed as above, ...	748.24	35.43	103.83	142.42	424.33	42.33
246.76 grams manure excreted, ...	227.02	22.54	40.80	52.76	93.24	17.68
Grams digested, ...	521.22	12.89	63.03	89.66	331.09	24.55
Minus hay and cotton-seed meal digested, . .	229.16	5.31	67.28	45.64	95.62	13.51
Apple pomace digested, ...	292.06	7.58	-	44.02	235.47	11.04
Per cent. digested, ...	73.64	62.64	-	68.94	85.65	43.50

Old Sheep III.

Amount consumed as above, ...	748.24	35.43	103.83	142.42	424.33	42.23
259.46 grams manure excreted, ...	238.39	27.27	49.63	47.25	96.31	17.93
Grams digested, ...	509.85	8.16	54.20	95.17	328.02	24.30
Minus hay and cotton-seed meal digested, . .	229.16	5.31	67.28	45.64	95.62	13.51
Apple pomace digested, ...	280.69	2.85	-	49.53	232.40	10.79
Per cent. digested, ...	70.77	23.55	-	77.57	84.58	42.51
Average per cent. three sheep digested, . .	70.60	42.81	-	67.31	84.30	43.41

Period IV.

Young Sheep I.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
850 grams English hay,	747.15	48.79	46.55	246.56	390.54	14.72
Minus 35.86 grams waste,	31.07	2.03	1.94	10.25	16.24	.61
Amount consumed,	716.08	46.76	44.61	236.31	374.30	14.11
397.61 grams manure excreted,	371.21	41.43	29.18	120.68	169.83	10.10
Grams digested,	344.87	5.33	15.43	115.63	204.47	4.01
Per cent. digested,	48.16	11.40	34.59	48.93	54.63	28.42

Young Sheep II.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
850 grams English hay,	747.15	48.79	46.55	246.56	390.54	14.72
374.71 grams manure excreted,	349.49	37.40	29.36	110.12	163.35	9.26
Grams digested,	397.66	11.39	17.19	136.44	227.19	5.46
Per cent. digested,	53.22	23.34	36.93	55.34	58.17	37.09

Young Sheep III.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
850 grams English hay,	747.15	48.79	46.55	246.56	390.54	14.72
Minus 56.29 grams waste,	39.16	3.89	3.37	10.80	20.05	1.06
Amount consumed,	707.99	44.90	43.18	235.76	370.49	13.66
363.01 grams manure excreted,	343.17	37.47	27.35	110.50	159.23	8.61
Grams digested,	364.82	7.43	15.83	125.26	211.26	5.05
Per cent. digested,	51.53	16.55	36.66	53.13	57.02	36.97
Average per cent. three sheep digested,	**50.97**	**17.10**	**36.06**	**52.47**	**56.61**	**34.16**

Period V.

Old Sheep II.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
900 grams English hay,	792.90	50.35	49.48	253.33	421.43	18.32
369.38 grams manure excreted,	341.68	40.25	28.77	105.68	157.28	9.70
Grams digested,	451.22	10.10	20.71	147.65	264.15	8.62
Per cent. digested,	56.91	20.06	41.86	58.28	62.68	47.05

Old Sheep III.

900 grams English hay,	792.90	50.35	49.48	253.33	421.43	18.32
339.15 grams manure excreted,	313.92	38.14	28.28	92.58	144.97	9.95
Grams digested,	478.98	12.21	21.20	160.75	276.46	8.37
Per cent. digested,	60.41	24.25	42.85	63.45	65.60	45.69
Average per cent. two sheep digested,	**58.66**	**22.16**	**42.36**	**60.87**	**64.14**	**46.37**

Period VI.

Young Sheep I.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
600 grams English hay,	528.30	34.02	32.97	171.59	278.41	11.31
200 grams Bibby's dairy cake,	178.90	16.35	42.08	16.60	85.98	17.89
Amount consumed,	707.20	50.37	75.05	188.19	364.39	29.20
324.71 grams manure excreted,	304.51	38.43	34.07	91.96	132.19	7.86
Grams digested,	402.69	11.94	40.98	96.23	232.20	21.34
Minus hay digested,	263.57	4.72	12.32	85.76	156.72	4.36
Bibby's dairy cake digested,	139.12	7.22	28.66	10.47	75.48	16.98
Per cent. digested,	77.76	44.16	68.11	63.07	87.79	94.91

Young Sheep II.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Amount consumed as above,	707.20	50.37	75.05	188.19	364.39	29.20
325.20 grams manure excreted,	304.22	36.60	38.03	92.15	129.63	7.82
Grams digested,	402.98	13.77	37.02	96.04	234.76	21.38
Minus hay digested,	287.08	7.69	12.44	95.83	166.41	5.00
Bibby's dairy cake digested,	115.90	6.08	24.58	.21	68.35	16.38
Per cent. digested,	64.78	37.19	58.41	1.27	79.50	91.56

Young Sheep III.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Amount consumed as above,	707.20	50.37	75.05	188.19	364.39	29.20
329.87 grams manure excreted,	310.61	40.07	34.42	97.22	131.57	7.33
Grams digested,	396.59	10.30	40.63	90.97	232.82	21.87
Minus hay digested,	272.23	5.63	12.09	91.17	158.75	4.18
Bibby's dairy cake digested,	24.36	4.67	28.54	.80	74.07	17.69
Per cent. digested,	69.51	28.56	67.82	-	86.15	98.88
Average per cent. three sheep digested,	70.68	36.64	64.78	32.17	84.48	95.12

Period VII.

Old Sheep II.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
600 grams English hay,	526.92	33.93	32.88	171.14	277.69	11.28
300 grams beet pulp,	277.86	15.67	27.42	47.71	185.44	1.61
Amount consumed,	804.78	49.60	60.30	218.85	463.13	12.89
271.34 grams manure excreted,	253.84	31.40	27.41	74.15	112.07	8.81
Grams digested,	550.94	18.20	32.89	144.70	351.06	4.08
Minus hay digested,	308.25	7.46	13.97	104.40	177.72	5.25
Beet pulp digested,	241.69	10.74	18.92	40.30	173.34	-
Per cent. digested,	86.98	68.54	69.00	84.47	93.47	-

Old Sheep III.

Amount consumed as above,	804.78	49.60	60.30	218.85	463.13	12.89
286.94 grams manure excreted,	268.58	33.60	30.11	74.72	120.97	9.19
Grams digested,	536.20	16.00	30.19	144.13	342.16	3.70
Minus hay digested,	308.25	7.46	13.97	104.40	177.72	5.25
Beet pulp digested,	227.95	8.54	16.22	39.73	164.44	-
Per cent. digested,	82.04	54.50	59.15	83.27	88.68	-
Average per cent. two sheep digested,	**84.51**	**61.52**	**64.08**	**83.87**	**91.08**	-

Period VIII.

Young Sheep I.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
600 grams English hay,	527.10	33.95	32.89	171.20	277.78	11.28
100 grams corn meal,	86.18	1.21	8.50	1.80	70.84	3.77
100 grams Armour's blood meal,	88.70	2.99	84.48	.78	-	.45
Amount consumed,	701.93	38.15	125.87	173.78	348.62	15.50
278.77 grams manure excreted,	260.51	27.72	33.94	82.03	110.17	6.64
Grams digested,	441.42	10.43	91.93	91.75	238.45	8.86
Minus hay digested,	262.97	4.71	12.29	85.57	156.36	4.35
	178.45	5.72	79.64	6.18	82.09	4.51
Minus corn meal digested,	76.66	-	5.95	-	66.59	3.43
Blood meal digested,	101.79	-	73.69	-	15.50	1.08
Per cent. digested,	100.+	-	88.41	-	-	-

Young Sheep II.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Amount consumed as above,	701.93	38.15	125.87	173.78	348.62	15.50
277.21 grams manure excreted,	258.72	27.09	40.28	75.80	109.26	6.29
Grams digested,	443.21	11.06	85.59	97.98	239.36	9.21
Minus hay and corn meal digested,	363.09	7.67	18.36	95.62	166.03	4.98
Blood meal digested,	80.12	3.39	67.23	2.36	73.33	4.23
Per cent. digested,	90.33	-	79.58	-	-	-
Average per cent. two sheep digested,	-	-	84.00	-	-	-

Period IX.

Old Sheep II.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
700 grams English hay, ...	618.59	39.84	38.59	200.92	326.00	13.24
200 grams soy bean meal, ...	173.92	9.97	70.77	8.19	48.30	36.70
Amount consumed, ...	792.51	49.81	109.36	209.11	374.30	49.94
274.77 grams manure excreted, ...	259.44	33.39	25.48	76.53	115.81	8.22
Grams digested, ...	533.07	16.42	83.88	132.58	258.49	41.72
Minus hay digested, ...	361.88	8.76	16.40	122.56	208.64	6.16
Soy bean meal digested, ...	171.19	7.66	67.48	10.02	49.85	35.56
Per cent. digested, ...	98.43	76.83	95.35	122.20	103.20	96.89

Old Sheep III.

Amount consumed as above, ...	792.51	49.81	109.36	209.11	374.30	49.94
306.24 grams manure excreted, ...	289.73	34.83	30.91	76.95	136.06	10.98
Grams digested, ...	502.78	14.98	78.45	132.16	238.24	38.96
Minus hay digested, ...	361.88	8.76	16.40	122.56	208.64	6.16
Soy bean meal digested, ...	140.90	6.22	62.05	9.60	29.60	32.80
Per cent. digested, ...	81.01	62.39	87.68	104.90	61.28	89.37
Average per cent. two sheep digested, . .	**89.72**	**69.61**	**91.51**	**113.55**	**82.24**	**93.13**

Period X.

Young Sheep I.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
550 grams English hay,	491.15	31.63	30.65	159.53	258.84	10.51
250 grams hominy feed,	221.33	6.97	25.81	12.08	155.17	21.29
Amount consumed,	712.48	38.60	56.46	171.61	414.01	31.80
294.91 grams manure excreted,	277.39	30.46	29.99	82.91	126.13	7.91
Grams digested,	435.09	8.14	26.47	88.70	287.88	23.89
Minus hay digested,	244.93	4.38	11.45	79.73	145.70	4.05
Hominy feed digested,	190.16	3.76	15.02	8.97	142.18	19.84
Per cent. digested,	85.87	53.95	58.19	74.25	91.63	93.19

Young Sheep II.

Amount consumed as above,	712.48	38.60	56.46	171.61	414.01	31.80
291.64 grams manure excreted,	273.50	29.32	30.91	82.27	124.06	6.95
Grams digested,	438.98	9.28	25.55	89.34	289.95	24.85
Minus hay digested,	266.89	7.15	11.56	89.10	154.71	4.64
Hominy feed digested,	172.09	2.13	13.99	.24	135.24	20.21
Per cent. digested,	77.75	30.56	54.20	1.99	87.16	94.93

Young Sheep III.

550 grams English hay,	491.15	-	-	-	-	-
Minus 8.86 grams waste hay,	7.78	-	-	-	-	-
Total hay consumed,	483.37	31.13	30.16	157.00	254.74	10.34
250 grams hominy feed,	221.33	6.97	25.81	12.08	155.17	21.29
Amount consumed,	704.70	38.10	55.97	169.08	409.91	31.63
308.66 grams manure excreted,	290.39	30.84	28.95	88.86	133.99	7.75
Grams digested,	414.31	7.26	27.02	80.22	275.92	23.88
Minus hay digested,	249.08	5.15	11.06	83.41	145.25	3.82
Hominy feed digested,	165.23	2.11	15.96	-	130.67	20.06
Per cent. digested,	74.65	30.27	61.84	-	84.21	94.22
Average per cent. three sheep digested,	**79.42**	**38.26**	**58.08**	**38.12**	**87.67**	**94.10**

Period XI.

Old Sheep II.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
1,200 grams Eureka silage corn fodder (dry),	480.96	37.76	47.23	157.27	230.38	8.32
Minus 96.86 grams waste,	49.58	4.88	4.54	16.92	22.35	.89
Amount consumed,	431.38	32.88	42.69	140.35	208.03	7.43
166.06 grams manure excreted,	155.83	19.84	18.05	40.58	74.60	2.77
Grams digested,	275.55	13.04	24.64	99.77	133.43	4.66
Per cent. digested,	63.88	39.66	57.72	71.09	64.14	62.72

Old Sheep III.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
1,200 grams Eureka silage corn fodder (dry),	480.96	37.76	47.23	157.27	230.38	8.32
185.54 grams manure excreted,	174.11	22.27	20.61	44.00	84.08	3.15
Grams digested,	306.85	15.49	26.62	113.27	146.30	5.17
Per cent. digested,	63.80	41.02	56.36	72.02	63.50	62.14
Average per cent. two sheep digested,	63.84	40.34	57.84	71.56	63.82	62.43

Period XII.

Young Sheep I.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
800 grams English hay, ...	718.16	46.39	48.40	231.82	374.59	16.95
Minus 48.57 grams waste, ...	42.26	2.93	2.61	13.83	22.00	.90
Amount consumed, ...	675.90	43.46	45.79	217.99	352.59	16.05
350.83 grams manure excreted, ...	327.04	36.37	27.41	106.75	148.28	8.24
Grams digested, ...	348.86	7.09	18.38	111.24	204.31	7.81
Per cent. digested, ...	51.61	16.31	40.14	51.03	57.95	48.66

Young Sheep II.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
800 grams English hay, ...	718.16	46.39	48.40	231.82	374.59	16.95
Minus 32.57 grams waste, ...	26.27	2.18	1.99	7.84	13.79	.69
Amount consumed, ...	691.89	44.21	46.41	223.98	360.80	16.26
331.97 grams manure excreted, ...	308.20	34.55	28.54	97.76	139.43	7.92
Grams digested, ...	383.69	9.66	17.84	126.22	221.37	8.34
Per cent. digested, ...	55.46	21.85	38.50	56.35	61.36	51.29
Average per cent. two sheep digested, . .	53.54	19.08	39.32	53.69	59.66	49.98

Period XXVI. (1903).

Old Sheep I.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
650 grams hay,	577.33	44.05	69.45	182.44	264.94	16.45
250 grams Bibby's dairy cake,	224.50	18.81	48.02	20.63	113.19	23.84
Total consumed,	801.83	62.86	117.47	203.07	378.13	40.29
318.61 grams manure excreted,	294.49	37.93	43.97	80.07	122.57	9.95
Amount digested,	507.34	24.93	73.50	123.00	255.56	30.34
Minus hay digested,	369.49	19.82	43.75	122.23	174.86	8.88
Bibby's dairy cake digested,	137.85	5.11	29.75	.77	80.70	21.46
Per cent. digested,	61.40	27.16	61.95	-	71.29	90.02

Old Sheep II.

Total consumed as above,	801.83	62.86	117.47	203.07	378.13	40.29
271.31 grams manure excreted,	251.40	34.92	37.36	66.72	103.65	8.75
Amount digested,	550.43	27.94	80.11	136.35	274.48	31.54
Minus hay digested,	369.49	19.82	43.75	122.23	174.86	8.88
Bibby's dairy cake digested,	180.94	8.12	36.36	14.12	99.62	22.66
Per cent. digested,	80.59	43.17	75.72	68.44	88.01	95.05

Old Sheep III.

Total consumed as above,	801.83	62.86	117.47	203.07	378.13	40.29
306.77 grams manure excreted,	284.81	39.67	44.40	70.15	119.25	11.34
Amount digested,	517.02	23.19	73.07	132.92	258.88	28.95
Minus hay digested,	369.49	19.82	43.75	122.23	174.86	8.88
Bibby's dairy cake digested,	147.53	3.37	29.32	10.69	84.02	20.07
Per cent. digested,	65.71	17.92	61.06	51.82	74.23	84.19
Average per cent. three sheep digested,	**69.23**	**29.42**	**66.24**	**60.13**	**77.84**	**89.75**

Period XXVIII. (1903).

Old Sheep I.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
600 grams hay,	529.50	40.40	63.70	167.32	242.99	15.09
900 grams hominy meal,	265.44	8.97	32.46	13.19	184.29	26.52
Total consumed,	794.94	49.37	96.16	180.51	427.28	41.61
287.38 grams manure excreted,	267.16	30.22	35.83	76.11	115.76	9.24
Amount digested,	527.78	19.15	60.33	104.40	311.52	32.37
Minus hay digested,	338.88	18.18	40.13	112.10	160.37	8.15
Hominy meal digested,	188.90	.97	20.20	-	151.15	24.22
Per cent. digested,	71.16	10.81	62.23	-	82.02	91.33

Old Sheep II.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Total consumed as above,	794.94	49.37	96.16	180.51	427.28	41.61
262.46 grams manure excreted,	242.88	31.36	34.54	63.12	104.95	8.91
Amount digested,	552.06	18.01	61.62	117.39	322.33	32.70
Minus hay digested,	338.88	18.18	40.13	112.10	160.37	8.15
Hominy meal digested,	213.18	-	21.49	5.29	161.96	24.55
Per cent. digested,	80.31	-	66.20	40.11	87.88	92.57

Old Sheep III.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Total consumed as above,	794.94	49.37	96.16	180.51	427.28	41.61
231.44 grams manure excreted,	215.03	28.08	32.00	51.74	93.34	9.87
Amount digested,	579.91	21.29	64.16	128.77	333.94	31.74
Minus hay digested,	338.88	18.18	40.13	112.10	160.37	8.15
Hominy meal digested,	241.03	3.11	24.03	16.67	173.57	23.59
Per cent. digested,	90.80	34.67	74.03	126.38	94.18	88.95
Average per cent. three sheep digested,	80.76	22.74	67.49	-	88.03	90.95

Summary of Coefficients (Per Cent.).

RATION.	Sheep Number.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Soy bean fodder,	Old Sheep I.,	63.56	26.29	84.35	39.74	76.09	66.33
	Old Sheep II.,	62.51	16.89	82.12	30.83	79.45	66.00
	Old Sheep III.,	64.53	19.97	82.41	46.13	77.92	63.93
Average,	. . . . .	**63.53**	**21.05**	**82.96**	**38.90**	**77.82**	**65.42**
Eureka silage corn fodder (green).	Old Sheep I.,	64.32	43.10	66.50	56.17	70.26	67.32
	Old Sheep II.,	68.57	41.76	66.85	63.65	74.35	65.68
	Old Sheep III.,	66.99	41.76	67.70	60.97	72.72	64.80
Average,	. . . . .	**66.63**	**42.21**	**67.02**	**60.26**	**72.44**	**65.93**
Eureka silage corn fodder (dry).	Old Sheep II.,	63.88	39.66	57.72	71.09	64.14	62.72
	Old Sheep III.,	63.80	41.02	56.36	72.02	63.50	62.14
Average,	. . . . .	**63.84**	**40.34**	**57.04**	**71.56**	**63.82**	**62.43**
Apple pomace,	Old Sheep I.,	67.39	42.23	-	55.43	82.73	44.21
	Old Sheep II.,	73.64	62.64	-	68.94	85.65	43.50
	Old Sheep III.,	70.77	23.55	-	77.57	84.53	42.51
Average,	. . . . .	**70.60**	**42.81**	-	**67.31**	**84.30**	**43.41**
English hay,	Young Sheep I.,	48.16	11.40	34.59	48.93	54.63	28.42
	Young Sheep II.,	53.22	23.34	36.93	55.34	58.17	37.09
	Young Sheep III.,	51.53	16.55	36.66	53.13	57.02	36.97
Average,	. . . . .	**50.97**	**17.10**	**36.06**	**52.47**	**56.61**	**34.16**
English hay,	Young Sheep I.,	51.61	16.31	40.14	51.03	57.95	48.66
	Young Sheep II.,	55.46	21.85	38.50	56.35	61.36	51.29
Average,	. . . . .	**53.54**	**19.08**	**39.32**	**53.69**	**59.66**	**49.98**
English hay,	Old Sheep II.,	56.91	20.06	41.86	58.28	62.68	47.05
	Old Sheep III.,	60.41	24.25	42.85	63.45	65.60	45.69
Average,	. . . . .	**58.66**	**22.16**	**42.36**	**60.87**	**64.14**	**46.37**
Bibby's dairy cake,	Young Sheep I.,	77.76	44.16	68.11	63.07	87.79	94.91
	Young Sheep II.,	64.78	37.19	58.41	1.27	79.50	91.56
	Young Sheep III.,	69.51	28.56	67.82	-	86.15	98.88
Bibby's dairy cake (1903),	Old Sheep I.,	61.40	27.16	61.95	-	71.29	90.02
	Old Sheep II.,	80.59	43.17	75.72	68.44	88.01	95.05
	Old Sheep III.,	65.71	17.92	61.06	51.82	74.23	84.19
Average,	. . . . .	**69.95**	**33.03**	**65.51**	**46.15**	**81.16**	**92.44**
Alma dried molasses-beet-pulp.	Old Sheep II.,	86.98	68.54	69.00	84.47	93.47	-
	Old Sheep III.,	82.04	54.50	59.15	83.27	88.68	-
Average,	. . . . .	**84.51**	**61.52**	**64.08**	**83.87**	**91.08**	-
Armour's blood meal,	Young Sheep I.,	100.+	-	88.41	-	-	-
	Young Sheep II.,	90.33	-	79.58	-	-	-
Average,	. . . . .	-	-	**84.00**	-	-	-
Medium green soy bean meal.	Old Sheep II.,	98.43	76.83	95.35	122.20	103.20	96.89
	Old Sheep III.,	81.01	62.39	87.68	104.90	61.28	89.37
Average,	. . . . .	**89.72**	**69.61**	**91.51**	**113.55**	**82.24**	**93.13**

Summary of Coefficients (Per Cent.) — Concluded.

RATION.	Sheep Number.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Marshall hominy feed, .	Young Sheep I.,	85.87	53.95	58.19	74.25	91.63	93.19
	Young Sheep II.,	77.75	30.56	54.20	1.99	87.16	94.88
	Young Sheep III.,	74.65	30.27	61.84	-	84.21	94.22
Hominy meal (1903), .	Old Sheep I., .	71.16	10.81	62.23	-	82.02	91.33
	Old Sheep II., .	80.81	-	66.20	40.11	87.88	92.57
	Old Sheep III., .	90.80	34.67	74.03	126.38	94.18	88.96
Average, ...	. . . . .	**80.09**	**32.05**	**62.78**	**60.68**	**87.85**	**92.52**

The Results discussed.

The more important results obtained from the several digestion experiments, the details of which are reported in the previous tables, are discussed as follows: —

Soy Bean Fodder (Brooks Medium Green). — The yield of fodder was light (about 6 tons to the acre), due to the cool summer of 1903. The plants were quite green, thickly set with leaves, well podded and the seed fairly well developed. In common with other legumes at a similar stage of growth, the fodder showed a noticeably high protein percentage, and only moderate quantities of fiber and extract matter. The three sheep ate the fodder readily and digested it quite evenly. Sheep II. refused small quantities of the coarse stems. The results agree fairly well with those already on record.[1]

Summary of Experiment (Per Cent.).

	Number of Different Lots.	Single Trials.	Dry Matter.	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
Sheep I., ...	1	1	63.56	26.29	84.35	39.74	76.09	66.33
Sheep II., ...	1	1	62.51	16.89	82.12	30.83	79.45	66.00
Sheep III., ...	1	1	64.53	19.97	82.41	46.13	77.92	63.93
Average, ...	1	3	63.53	21.05	82.96	38.90	77.82	65.42
Average, previous experiments,	5	12	[2]65.00	-	75.00	46.00	75.00	48.00
Clover for comparison, . . .	3	7	66.00	-	70.00	54.00	72.00	64.00
Cow peas for comparison, . .	2	4	[2]68.00	23.00	76.00	60.00	81.00	59.00

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[1] See especially Phelps' work in the reports of the Storrs Experiment Station for 1896 and 1898, and the summary reported in Lindsey's compilation, fourteenth report of the Hatch Experiment Station, p. 198.

[2] Organic matter.

The total dry matter of the soy bean fodder appears to be slightly less digestible than that of other legumes, — clover, Canada field peas and cow peas, — due to its characteristic hard, woody stems. Attention is called to the fact that the digestion coefficient of the fiber in the soy beans is relatively low (39 and 46 per cent.), as compared with those for the clover and cow peas (54 and 60 per cent.). Soy beans will find their chief use in the farm economy as a soiling and silage crop. This subject will be discussed more fully at a later date.

Eureka Silage Corn. — This was a large southern dent variety, 12 to 13 feet tall, which is held in high esteem for silage purposes by the farmers of Worcester County. It is claimed that it will produce several matured ears to each stalk under average summer conditions. The season of 1903 was noticeably cool, and when the corn was cut, September 12–18, it was quite green, the kernels just forming. This variety is being further studied during the present season (1904), and its value as compared with the smaller varieties will be discussed in a subsequent report.

The three sheep showed only slight variations in their ability to digest the corn. The following figures show the average results of all trials with immature dent varieties, as compared with Eureka. The results are quite similar, except that the fiber in case of the Eureka showed a slightly lower digestibility.

Summary of Experiment (Per Cent.).

	Number of Different Lots.	Single Trials.	Dry Matter.	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
Dent corn fodder, immature,	4	11	68.00	-	66.00	67.00	71.00	68.00
Eureka (present trial),	1	3	67.00	42.00	67.00	60.00	72.00	66.00

Apple Pomace. — In the sixteenth report of this station (pp. 63–80) are given the results of a digestion test with apple pomace. In that experiment the pomace was fed with a reasonable quantity of hay. In the present trial a smaller amount of hay was fed, and in addition each sheep was given 150 grams of cotton-seed meal, in the hope of increasing the digestibility of the protein in apple pomace.[1] For the sake of comparison, the coefficients obtained in both experiments follow: —

Summary of Experiment (Per Cent.).

	Dry Matter.	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
Former Experiment, Hay and Pomace.						
Sheep I.,	67.29	42.23	-	55.43	82.73	44.21
Sheep II.,	73.64	62.64	-	68.94	85.65	43.50
Sheep III.,	70.77	23.55	-	77.57	84.53	42.51
Average,	70.60	42.81	-	67.31	84.30	43.41
Present Experiment, Hay, Cotton-seed Meal and Pomace.						
Sheep I.,	65.63	60.91	-	35.82	80.31	51.99
Sheep II.,	71.83	47.20	-	63.93	83.59	39.10
Sheep III.,	80.06	56.11	-	84.95	89.53	50.56
Average,	72.51	54.74	-	61.57	84.48	47.22
Average, both trials,	71.50	48.70	-	64.40	84.40	45.30

Both experiments were made with the same lot of sheep. The sheep digested the total dry matter of the pomace rather more evenly in the present than in the former trial. It is evident that Sheep I. was unable to utilize as much as the other two sheep. It will be seen that the fiber, extract matter and fat, comprising the larger part of the dry matter of the pomace, were digested to approximately the same degree in both experiments. The protein content of the pomace is small, about 1 per cent., and it has not been possible by present methods to fix its digestibility. It probably is digested to a considerable degree, although the results do not make it apparent. The several experiments show the pomace to be as digestible as the better grades of corn silage. Its value for feeding purposes will be further discussed under a separate heading.

English Hay. — The hay used in the present series consisted of a mixture of timothy and redtop, cut in late bloom, and well cured. Two different analyses of this hay are reported in the table of composition. It contained rather less protein and more fiber than the hay usually employed by us for digestion experiments.

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[1] In determining the digestibility of the apple pomace, average digestion coefficients were taken for the cotton-seed meal. See fourteenth report of this station, p. 209.

The young sheep (Period IV.) did not digest the hay as fully as did the old sheep (Period V.) The experiment was repeated with two of the young sheep in Period XII., in which case higher coefficients were obtained, though they did not equal those secured with the old sheep. The hay showed a fair digestibility, and no extreme variations were noted among the several sheep in the same trial. The results, however, do not agree as closely as most of the former experiments with hay carried out at this station.

Bibby's Dairy Cake, made by J. Bibby & Sons of Liverpool, Eng., is composed principally of ground cotton-seed, cereals such as barley and wheat, molasses, fenugreek and salt. It has a pleasing taste and smell, and appears to be highly relished by farm animals. The results of two distinct trials are reported, the first made during the winter of 1903 with three old sheep, and the second made during the winter of 1904 with three young sheep. The first sample was purchased from the stock of a retail grain dealer, and the second was obtained directly from a recent importation. Both lots were in good condition, and resembled each other closely in chemical composition. In the second trial the cake was not relished by Sheep III., although he was induced to eat it after a few days. The cake, which was ground before being fed, acted as a laxative, at first producing soft fæces, which gradually hardened as the period advanced.

Summary of Experiment (Per Cent.).

	Dry Matter.	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
Sheep I., old,	61.40	27.16	61.95	–	71.29	90.02
Sheep II., old,	80.59	43.17	75.72	68.44	88.01	95.05
Sheep III., old,	65.71	17.92	61.06	51.82	74.23	84.19
Average, three sheep,	69.23	29.42	66.24	60.13	77.84	89.75
Sheep I., young,	77.76	44.16	68.11	63.07	87.79	94.91
Sheep II., young,	64.78	37.19	58.41	1.27	79.50	91.56
Sheep III., young,	69.51	28.56	67.82	–	86.15	98.88
Average, three sheep,	70.68	36.63	64.78	32.17	84.14	95.11
Average, six sheep,	69.95	33.02	65.51	46.15	80.99	92.48

Especially wide variations are noted in the case of the old sheep. Sheep II. seemed to have a strong digestion, while Sheep I., judging from the results, was slightly out of condition. Such extreme variations are not apparent in case of the young sheep. In both experiments considerable difficulty was experienced in digesting the crude fiber, due probably to the fact that it was derived largely from cottonseed hulls. The protein was moderately digestible, while the extract matter and fat yielded fairly high coefficients. In general it may be said that the dairy cake was only moderately digested, and possessed a nutritive value similar to standard wheat middlings. An experiment with Bibby's cake fed to four dairy cows has been completed, and the relative commercial and nutritive value of this concentrate will be more fully discussed in that connection.

Dried Molasses-beet-pulp. — This material, manufactured by the Alma Sugar Company of Alma, Mich., consisted of beet pulp and crude molasses dried.[1] In appearance it resembled ordinary black tea. The analysis showed it to be low in protein and high in fiber and extract matter; only traces of fat were found. A more detailed analysis of the product showed that the crude protein consisted of 7.01 per cent. of true albuminoids and 2.90 per cent. of amides; the extract matter contained 13.80 per cent. of cane sugar and 1.83 per cent. of dextrose. The pentosans (18.40 per cent.) were in all probability largely in the form of a hemi-cellulose, and would also be included in the extract matter. The above figures are based on the material in its natural state, with 8.58 per cent. moisture. The results of the experiment with two old sheep follow: —

Summary of Experiment (Per Cent.).

	Dry Matter.	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
Sheep II., ...	86.98	68.54	69.00	84.47	93.47	-
Sheep III., ...	82.04	54.50	59.15	83.27	88.68	-
Average, . . .	84.51	61.52	64.08	83.87	91.08	-
Corn meal for comparison,	89.00	-	70.00	-	94.00	91.00

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[1] See Bulletin No. 99 for a description of the process and a full discussion of its value.

The sheep ate the material readily and digested it without trouble. From the high average digestibility and an experiment with dairy animals elsewhere reported,[1] it is believed the dried pulp has a feeding value about 10 per cent. less than corn meal.

Armour's Blood Meal, especially prepared for cattle feeding, was found to contain 95.24 per cent. of protein and only traces of fat and fiber. Its mechanical condition was all that could be desired. As the detailed experiment shows, it was fed to two young sheep in combination with hay and corn meal. In figuring the digestibility of the blood the coefficients for the corn meal were taken from Lindsey's compilation.[1] The two sheep digested the dry matter of the blood quite thoroughly, namely, 95.14 per cent. The protein was not as thoroughly digested, — 83.99 per cent.; but this must be more apparent than real, and due to the influence of the other constituents. It is probable that the protein of the hay and corn meal was not quite as thoroughly digested as the coefficients call for, leaving a slight excess undigested, which must of necessity be charged against the blood. This supposition is strengthened by the fact that there is a small plus balance of extract matter and a minus balance of fiber, which show digestible divergences from the established hay and corn meal coefficients. Judging from the digestibility of the dry matter of the blood, we may safely conclude that the blood protein must be quite thoroughly utilized by farm animals. An experiment with dried blood as a source of protein for dairy animals has been completed, and its economic value will be discussed when the results of that experiment are published.

Soy Bean Meal (Brooks Medium Green). — The beans were grown at the station, and coarsely ground before being fed. They were of the usual good quality, containing 40.69 per cent. of protein and 21.10 per cent. fat in dry matter. The coefficients obtained in 1903 follow, and also those secured in the present trial: —

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[1] *Loco citato.*

Summary of Experiment (Per Cent.).

	Dry Matter.	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
Sheep II., old, 1903, ...	95.46	44.93	92.80	194.62	93.04	95.67
Sheep III., old, 1903, ...	87.32	41.70	89.34	85.48	89.29	91.34
Average, ...	91.39	43.32	91.07	140.05	91.17	93.51
Sheep II., old, 1904, ...	98.43	76.83	95.35	122.20	103.20	96.51
Sheep III., old, 1904, ...	81.01	62.39	87.68	104.90	61.28	89.37
Average, ...	89.72	69.61	91.51	113.55	82.24	92.94
Average, four trials, ...	90.56	56.47	91.29	126.79	86.71	93.23
Average, two German trials for comparison,	[1]85.00	-	87.00	-	62.00	94.00

[1] Organic matter.

The soy bean, in common with other concentrates rich in nitrogen, frequently causes digestive irregularities. In the present trial Sheep III. was not able to digest the feed as thoroughly as Sheep II. The same condition was apparent last year, although not quite as marked. It is evident that the beans are as a rule quite thoroughly digested, especially the protein and fat, which are the two important constituents. The coefficients for the fiber are, of course, incorrect, due probably to the favorable influence of the rich protein concentrate in increasing the digestibility of the hay carbohydrates. The small amount of fiber present — about 5 per cent. — renders a knowledge of the exact percentage digestible of minor importance. The extract matter was also largely digested, — probably 80 or more per cent., — although the trials made thus far have not given sufficiently definite results to enable one to fix any exact coefficient.

Hominy Feed, or Chop. — As used for cattle feeding, this consists of the hull, germ, some of the gluten and soft starch. The two samples tested were of good average quality. The results of six trials are presented. Three of them were made with old sheep in 1903, and three with young sheep in 1904.

Summary of Experiment (Per Cent.).

	Dry Matter.	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
Sheep I., old, 1903,	71.16	10.81	62.23	-	82.02	91.33
Sheep II., old, 1903,	80.31	-	66.20	40.11	87.88	92.57
Sheep III., old, 1903,	90.80	34.67	74.03	126.50	88.03	90.95
Average,	80.75	22.74	67.48	-	85.97	91.61
Sheep I., young, 1904,	85.87	53.95	58.19	74.25	91.63	93.19
Sheep II., young, 1904,	77.75	30.56	54.20	1.99	87.16	94.88
Sheep III., young, 1904,	74.65	30.27	61.84	-	84.24	94.22
Average,	79.42	38.26	58.07	38.12	87,66	94.09
Average, both experiments,	80.08	30.50	62.77	-	86.81	92.85
Corn meal for comparison,	89.00	-	70.00	-	94.00	91.00

In the first trial Sheep I. evidently had a somewhat weakened digestion. This condition has already been referred to, and this sheep was dropped during 1904. Sheep III. appeared to have digested the hominy quite thoroughly, while Sheep II. gave results midway between the other two. Just why the three sheep should have shown such variable results with a feed that is supposed to be easily digested, is not clear. In the second trial, with a different sample and with the young sheep, the results also vary more than one would expect. Sheep III. was unable to digest the starchy matter as well as the other two, but made better use of the protein. The percentage of fiber contained in the hominy is relatively small, and the results differ so noticeably that they must be considered worthless. Both lots of sheep utilized the starchy matter and fat to about the same degree; the young sheep failed to digest the protein, as well as the old sheep. The average results of the two experiments must be regarded as giving a fairly good idea of the digestibility of the several fodder groups. It has been assumed hitherto that hominy was as digestible as corn meal; but, in view of the results obtained, this opinion is no longer tenable. The total dry matter of the hominy seems to be about 9 per cent. less digestible than that of the corn. This deficiency apparently falls largely on the protein and extract matter. Corn meal as found upon the market contains on an average 14 per cent. of water, or 1,720 pounds of dry matter to the ton; while hominy shows 9 per cent. of water, or 1,820 pounds of dry matter to the ton. Applying the digestion coefficients for dry matter obtained in both cases, hominy would yield 1,456 pounds and corn meal 1,531 to the ton, and would show the corn meal to be about 5 per cent. more valuable than the hominy. It is proposed to repeat the digestion test with still another sample, and also to compare the two feeds with milch cows. The fact must not be overlooked that different samples of both grains, more particularly the hominy, are likely to vary somewhat in nutritive value, hence too positive conclusions should not be drawn. On the basis of our present knowledge, it may be said that both feeds have similar nutritive values.

Eureka Silage Corn Fodder. — This was a cured sample of the variety previously described. In composition it differed somewhat from the green sample, by containing more ash, noticeably more fiber and less extract matter. Whether this change was the result of sampling, or whether it was brought about by the curing process, it is difficult to say. In case of the green corn, small lots were cut every two or three days during the experiment, each lot being carefully sampled and moisture determinations made immediately. At the end of the trial equal weights of each sample were mixed, and this mixture held to represent the corn fed during the entire experiment. To secure as fair a sample as possible of the material to be cured, a considerable quantity was cut about the middle of the digestion trial with the green corn, and placed in stooks in the field. The stooks were removed to the barn before snow came. In spite of the care taken, differences in the composition of the two lots would be likely to occur. At the time of feeding the cured material, in early March, it still contained 60 per cent. of water. It was finely cut before feeding, and, though somewhat mouldy on the outside, proved to be in fairly good condition. Because of the unexpected large water content. the sheep did not receive a sufficient amount daily, — 1,200 grams, — although the results show that they suffered no great loss in live weight during the period. Sheep III. ate the ration clean, while Sheep II. refused a noticeable amount of the coarser portions. The following figures show the results with the dry fodder; for comparison, the results obtained with the green corn are also stated: —

Summary of Experiment (Per Cent.).

	Dry Matter.	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
Sheep II., old, dry fodder, .	63.88	39.66	57.72	71.09	64.14	62.72
Sheep III., old, dry fodder, .	63.80	41.02	56.36	72.02	63.50	62.14
Average, ...	63.84	40.34	57.04	71.56	63.82	62.43
Sheep I., old, green fodder, .	64.32	43.10	66.50	56.17	70.26	67.32
Sheep II., old, green fodder, .	68.57	41.76	66.85	63.65	74.34	65.68
Sheep III., old, green fodder, .	66.99	41.76	67.70	60.97	72.72	64.80
Average, ...	66.63	42.21	67.02	60.26	72.44	65.93

The coefficients obtained are concordant, and the experiment may be considered quite satisfactory. In comparing the results of the two experiments, it will be noticed that the dry fodder was not as well digested as the green material. This may be accounted for partly on the ground that the sheep received the green fodder in September, after having been at pasture all summer, while the dried material was fed in March, after they had been in similar experiments for six months; and partly because previous experiments have demonstrated that in case of very coarse fodders sheep digest the green substance a little more thoroughly than the cured. For some reason the fiber in the dry material was more fully digested than in the green substance. This may be due to the fact that in the cured fodder some of the extract matter had been converted into a hemi-cellulose, which resisted the action of the chemical solvents, but yielded to the influence of the digestive fluids. In general, it may be said that the results obtained with the Eureka corn compare very favorably with those obtained by other experimenters with the southern varieties at a similar stage of growth.

2. THE DIGESTIBILITY OF GALACTAN.

REPORTED BY J. B. LINDSEY.[1]

Those carbohydrates that can be removed from plants and seeds by the action of dilute mineral acid and alkali, and that are soluble in F. Schulze's reagent, E. Schulze has termed hemi-celluloses. Under this heading he has brought the mother substances, — dextran, levulan, mannan, galactan, araban and xylan; which yield on inversion the sugars, — dextrose, levulose, mannose, galactose, arabinose and xylose. These hemi-celluloses are intermixed with the true celluloses in the cell walls of the plants and seeds. They have been frequently recognized as reserve material, being used by the embryo during the sprouting of the seed. The levulan and mannan have not been found generally distributed, while the araban and xylan (pentosans) constitute fully one-third of the extract matter of all hays and straws, are quite prominent in the hull and bran of most grain seeds, and are even found in the endosperm and cotyledons of many seeds.

Galactan was first extracted from lucerne seeds by Muntz,[2] and was converted into galactose by boiling with dilute acid. E. Schulze[3] and his co-workers found considerable galactan in the seeds of the blue lupine, and as a result assumed that this hemi-cellulose might be very generally distributed in agricultural plants. Lindsey and Holland[4] determined the percentage of galactan in a large number of hays, straws and concentrated feeds. The results of their work showed the presence of quite small amounts of galactan in the non-leguminous plants and seeds. In the leguminous plants from 3 to 4 per cent. was found, while in leguminous seeds the amount varied from 1½ to 14 per cent.

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[1] This experiment was carried out by Mr. E. S. Fulton of the class of 1904 of the Massachusetts Agricultural College, who expressed a desire to undertake work of this character for a graduation thesis. The sheep and apparatus belonging to the department of foods and feeding were placed at his disposal. The digestibility of the hay used had already been determined. Mr. Fulton assumed charge of the sheep, and prepared the fæces for analysis in the station laboratory. The analytical work was done at the college laboratory, under the supervision of Prof. C. Wellington. Mr. Fulton expresses his thanks to Professor Wellington and also to Dr. Lindsey and his co-workers for the many helps and suggestions received.

[2] Bul. Soc. Chem. (2), 37, p. 409.

[3] Zeitsch. f. physiol. Chem. Bd. 14, Heft. 3, Zeitsch. f. physiol. Chem. Bd. 16, Hefts. 4 and 5.

[4] Ninth report of the Hatch Experiment Station, pp. 92-96.

The method[1] employed was the one proposed by Tollens and his pupils, and consisted in principle of oxidizing a given amount of the plant or seed with a solution of slightly diluted nitric acid, and collecting the resulting mucic acid, after further treatment for the removal of impurities, on a tared filter.

No experiments are on record relative to the digestibility of galactan, hence the undertaking of this trial. Alsike clover seed was selected because it contained a noticeable quantity of galactan. It was ground reasonably fine, and fed in connection with hay, the digestibility of which had been previously determined. The experiment was conducted in the usual way, three young Southdown wethers being employed, and passed off without any disturbances.

TABULATED DATA OF THE EXPERIMENT.

Composition of Feed Stuffs (Per Cent.).

[Dry matter.]

FEEDS.	Galactan.	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
Hay,[2]	1.72	6.53	6.23	33.00	52.27	1.97
Clover seed, . . .	8.07	5.88	34.29	13.12	41.42	5.29

Composition of Fæces (Per Cent.).

[Dry matter.]

Sheep.	FEEDS.	Galactan.	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
I., .	Hay and clover seed,	.99	11.57	11.97	29.27	44.43	2.76
II., .	Hay and clover seed,	.95	11.21	13.11	30.23	42.84	2.61
III., .	Hay and clover seed,	1.02	11.32	12.63	28.94	44.49	2.62
I., .	Hay,[2]	.88	11.16	7.86	32.51	45.75	2.72
II., .	Hay, ...	.76	10.70	8.40	31.51	46.74	2.65
III., .	Hay, ...	1.07	10.92	7.97	32.20	46.40	2.51

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[1] *Loco citato.*

[2] The figures for all constituents, excepting galactan, in hay and hay manures were determined in a previous experiment.

Dry Matter Determinations made at the Time of weighing out the Foods, and Dry Matter in Manure excreted, estimated from Air-dry Fæces (Per Cent.).

Sheep.	FEEDS.	Hay.	Clover Seed.	Manure.
I., . .	Hay and clover seed, ...	88.85	91.53	94.05
II., . .	Hay and clover seed, ...	-	-	93.70
III., . .	Hay and clover seed, ...	-	-	94.07
I., . .	Hay, ...	-	-	93.36
II., . .	Hay, ...	-	-	93.27
III., . .	Hay, ...	-	-	93.25

Table showing Food fed, Water drank daily, and Daily Amount of Manure excreted.

[Food consumed daily: 600 grams hay, 200 grams clover seed, 5 grams salt.]

DATE.	SHEEP I.			SHEEP II.			SHEEP III.		
	Manure excreted daily (Grams).	Sample Air Dry (Grams).	Water drank daily (Cubic Centimeters).	Manure excreted daily (Grams).	Sample Air Dry (Grams).	Water drank daily (Cubic Centimeters).	Manure excreted daily (Grams).	Sample Air Dry (Grams).	Water drank daily (Cubic Centimeters).
March 20,	922.0	33.24	1,590.0	741.0	29.29	2,290.0	663.0	24.66	2,415.0
" 21,	853.0	29.16	1,060.0	888.0	31.98	1,865.0	879.0	31.60	2,410.0
" 22,	829.0	30.11	1,615.0	968.0	28.55	2,500.0	968.0	33.29	2,425.0
" 23,	799.0	29.56	1,350.0	1,059.0	32.02	2,500.0	822.0	32.29	2,400.0
" 24,	738.0	27.60	1,855.0	852.0	28.14	2,500.0	973.0	33.39	2,500.0
" 25,	909.0	31.64	1,950.0	949.0	29.02	2,500.0	964.0	33.93	2,500.0
" 26,	927.0	33.69	1,750.0	1,316.0	33.50	2,500.0	1,050.0	36.21	2,500.0
Average,	853.9	30.71	1,595.7	963.3	30.36	2,379.3	878.4	32.19	2,450.0

	Pounds.
Weight of Sheep I. at beginning of period,	99.25
Weight of Sheep II. at beginning of period,	94.75
Weight of Sheep III. at beginning of period,	91.50
Weight of Sheep I. at end of period,	99.50
Weight of Sheep II. at end of period,	94.00
Weight of Sheep III. at end of period,	91.00

Sheep I.

	Dry Matter (Per Cent.).	Galactan (Per Cent.).	Ash (Per Cent.).	Protein (Per Cent.).	Fiber (Per Cent.).	Nitrogen-free Extract (Per Cent.).	Fat (Per (Cent.).
600 grams hay fed,	533.10	9.17	34.81	33.21	175.92	278.65	10.50
200 grams clover seed,	183.06	14.77	10.76	62.77	24.02	75.82	9.68
Total consumed,	716.16	23.94	45.57	95.98	199.94	354.47	20.18
307.10 grams manure excreted,	288.83	2.86	33.42	34.57	84.54	128.33	7.97
Grams digested,	427.33	21.08	12.15	61.41	115.40	226.14	12.21
Minus hay digested,[1]	265.95	6.90	4.82	12.41	87.93	156.85	4.05
Clover seed digested,	161.38	14.18	7.33	49.00	27.47	69.29	8.16
Per cent. digested,	88.16	96.01	68.12	78.06	114.36	91.39	84.30

Sheep II.

	Dry Matter (Per Cent.).	Galactan (Per Cent.).	Ash (Per Cent.).	Protein (Per Cent.).	Fiber (Per Cent.).	Nitrogen-free Extract (Per Cent.).	Fat (Per (Cent.).
600 grams hay fed,	533.10	9.17	34.81	33.21	175.92	278.65	10.50
200 grams clover seed,	183.06	14.77	10.76	62.77	24.02	75.82	9.68
Total consumed,	716.16	23.94	45.57	95.98	199.94	354.47	20.18
308.60 grams manure excreted,	284.47	2.70	34.03	37.29	86.00	121.87	7.42
Grams digested,	431.69	21.24	11.54	58.69	113.94	232.60	12.76
Minus hay digested,[2]	289.69	7.28	7.87	12.53	98.25	166.55	4.64
Clover seed digested,	142.00	13.96	3.67	46.16	15.69	66.05	8.12
Per cent. digested,	77.57	94.52	34.11	73.54	65.32	87.11	83.88

Sheep III.

	Dry Matter (Per Cent.).	Galactan (Per Cent.).	Ash (Per Cent.).	Protein (Per Cent.).	Fiber (Per Cent.).	Nitrogen-free Extract (Per Cent.).	Fat (Per (Cent.).
600 grams hay fed,	533.10	9.17	34.81	33.21	175.92	278.65	10.50
200 grams clover seed,	183.06	14.77	10.76	62.77	24.02	75.82	9.68
Total consumed,	716.16	23.94	45.57	95.98	199.94	354.47	20.18
321.90 grams manure excreted,	302.81	3.09	34.28	38.24	87.63	134.72	7.93
Grams digested,[3]	413.35	20.85	11.29	57.74	112.31	219.75	12.25
Minus hay digested,	274.71	6.55	5.76	12.17	93.47	158.89	3.88
Clover seed digested,	138.64	14.30	5.53	45.57	18.84	60.86	8.37
Per cent. digested,	75.74	96.82	51.39	72.60	78.43	80.27	86.47

[1] Used average coefficient of Sheep I., Periods IV. and XII.

[2] Used average coefficient of Sheep II., Periods IV. and XII.

[3] Used coefficients of Sheep III., Period IV.

SUMMARY OF THE RESULTS.

Composition of the Feeds (Per Cent.).

	Galactan.[1]	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
Hay, ...	1.72	6.53	6.23	33.00	52.27	1.97
Clover seed, . . .	8.07	5.88	34.29	13.12	41.42	5.29

Digestibility of the Feeds (Per Cent.).

	Dry Matter.	Galactan.	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
Hay (all sheep), . .	53.50	75.35	20.50	37.00	55.00	59.00	42.00
Clover seed, Sheep I.,	88.16	96.01	68.12	78.06	114.36	91.39	84.30
Clover seed, Sheep II.,	77.57	94.52	34.11	73.54	65.32	87.11	83.88
Clover seed, Sheep III.,	75.74	96.82	51.39	72.60	78.43	80.27	86.47
Average, . . .	80.49	95.78	51.21	74.73	86.04	86.26	84.55

The analysis and digestibility of the hay were made in connection with a series of digestion experiments at the station. It appeared to contain rather more galactan than other samples examined.[2]

A previous complete analysis of alsike clover seed does not appear to be recorded. It contained a high percentage of protein and a normal amount of galactan.

The results of the digestion experiment with the three sheep show the *total dry matter* of the clover seed meal to have been fairly well digested, although the coefficients are noticeably lower than those on record for soy beans, peas, vetch and lupine (85 to 90 per cent.).

The galactan in the hay is shown to be 75 per cent. digestible. Because of the small quantity present, the results are of minor importance. All three sheep digested the galactan in the clover seed quite thoroughly. Such a result was to have been expected, for the reason that in the seed the galactan is supposed to be comparatively free from in-crusting substances, which have been shown by various investigators to seriously interfere with the digestibility of the several fodder groups.[1] Naturally, no positive conclusions should be drawn from the present single investigation. Knowing, however, the physiological and chemical character of the galactan, as well as the digestion coefficients obtained with starch and with the pentosans, — bodies of similar character, — it is reasonably safe to conclude that the results secured give a fairly correct idea of the ability of the animal to utilize the galactan group.

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[1] It may be assumed that the galactan belongs almost wholly to the nitrogen-free extract matter.

[2] Whether the substance obtained was pure galactan, or consisted partly of impurities that it was not possible to remove, it is difficult to say. Lindsey and Holland found a trifle less than 1 per cent. in another sample.

The pentosans, fifteenth report of the Hatch Experiment Station, p. 118.

3. The Feeding Value of Apple Pomace.

BY J. B. LINDSEY.

There is often considerable discussion in the agricultural press and among farmers concerning the value of apple pomace as a food for dairy and beef cattle; with a view to getting a little positive data, this station instituted a number of experiments, the results of which are here briefly stated.

(a) *Composition of Apple Pomace (Per Cent.).*

	Water.	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
Sample I., ...	81.40	.73	.94	3.00	13.03	.90
Sample II., ...	80.20	.60	1.01	3.19	13.73	1.27
Corn silage for comparison,	80.00	1.10	1.70	5.40	11.10	.70

It will be seen from the above figures that apple pomace is a carbohydrate feed similar to corn silage. It contains about the same amount of water (four-fifths), rather less protein and fiber, and a larger proportion of extract matter. Whether the extract matter in the pomace is as valuable, pound for pound, as that contained in the corn, has not been thoroughly demonstrated.

(b) *Digestibility of Apple Pomace.*

The value of a feed cannot always be measured by its composition. A food is valuable as a source of nutrition only in so far as its various constituents can be digested and assimilated. This station has made two different experiments to ascertain the digestibility of the pomace, and the detailed results are to be found elsewhere in this report. The summary follows: —

Summary of Experiments (Per Cent.).

	Number of Single Trials.	Dry Matter.	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
Apple pomace (first experiment), . .	3	72.5	54.7	-	61.6	84.5	47.2
Apple pomace (second experiment), . .	3	70.6	42.8	-	67.3	84.3	43.4
Average, ...	6	71.5	48.7	-	64.4	84.4	45.3
Dent corn silage (for comparison), . .	17	64.0	-	52.0	62.0	69.0	85.0
Flint corn silage (small varieties), . .	11	75.0	-	65.0	77.0	79.0	82.0

The results show the total dry matter in apple pomace to be about as digestible as in the best grades of silage. The protein content of the pomace is small, — about 1 per cent., — and it has not been possible by present methods to fix its digestibility. Judging from the composition and digestibility of the pomace, one would feel justified in assuming that, pound for pound, it should approach in feeding value an average quality of corn silage.

(*c*) *Experiments with Dairy Animals.*

While this station has not carried out any exhaustive comparative tests with pomace and other coarse feeds, it has fed the pomace a number of seasons to dairy animals. The material was drawn fresh from the mill, and placed in a large pile under cover. A noticeable quantity of juice gradually drained from it, but it kept in good condition for two months. The animals received from 15 to 30 pounds daily, ate it readily, and the results were quite satisfactory. In one case two cows were fed alternately four weeks at a time on grain and hay, and on grain, hay and pomace; 25 pounds of pomace were compared with 5 pounds of hay. During the pomace period the animals produced 1,153 pounds of milk, and gained 24 pounds in live weight; during the hay period, 1,138 pounds of milk, and lost 6 pounds in weight. On this basis, 5 pounds of pomace were more than equivalent to 1 pound of hay. Judging from this feeding test and from the composition and digestibility of the pomace, it seems probable that 4 pounds, when fed in what is termed a "balanced ration," would be equal in feeding value to 1 pound of good cow hay.

The Vermont Experiment Station has fed apple pomace for four years, using in all twenty cows in the several trials. The pomace was shovelled into the silo, levelled off, and kept in good condition without further care. In some cases it was placed on top of the corn silage after the latter had settled. The quantity fed varied from 10 to 35 pounds daily, with no unfavorable effects. As a result of the several experiments, the Vermont station concludes that the pomace is equivalent in feeding value to an equal weight of average corn silage,[1] and that it is without injurious effect on the flavor of milk and butter.

Farmers are cautioned not to feed too large quantities at first, but to begin with 10 pounds daily, and to gradually increase the quantity to 30 pounds, taking a week or more in which to do it. In this way, danger of a sudden milk shrinkage, or of the animals getting "off feed," as is sometimes reported, may be avoided. Judging from all the data available, it is believed that farmers living in the vicinity of cider mills will find it good economy to utilize the pomace as a food for their dairy stock.

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[1] There is doubt in the mind of the writer whether pomace would prove fully equal to well-preserved and well-eared corn silage; it certainly would approach it in feeding value, and ought to be fully utilized.

4. BLOMO FEED FOR HORSES.

J. B. LINDSEY AND P. H. SMITH.

Blomo feed[1] is a mixture of ground corn stalks, or similar material, with dried blood and refuse molasses. It is almost black in color, slightly sticky to handle, and of a bulky, fibrous nature. It has been extensively advertised as a satisfactory partial oat substitute for horses, and is guaranteed to contain 15 per cent. protein and 1.19 per cent. fat. Feeds of similar character have been in use for some time in Europe.

Composition of Blomo Feed (Per Cent.).

	Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Blomo feed, ...	20.2	9.0	14.7	12.1	43.3	.7
Oats for comparison, .	11.0	2.9	12.9	8.5	59.6	5.1
Corn for comparison, .	11.0	1.4	10.8	1.9	70.2	4.7

It will be seen from the foregoing table that Blomo feed contains more protein and decidedly less fat and starchy matter than either oats or corn. Part of the extract matter consists of cane sugar derived from molasses. The ash content is considerably in excess of either oats or corn.

Digestibility of Blomo Feed.

A digestion experiment[2] was recently completed at this station, with the following results: —

Digestion Coefficients (Per Cent.).

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Blomo feed, ...	66.7	31.4	62.7	61.4	76.0	15.3
Oats for comparison, . . .	72.0	33.0	86.0	31.0	79.0	82.0
Corn (cracked) for comparison,	88.0	-	76.0	-	96.0	73.0

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[1] Made by the Blomo Manufacturing Company, New York, N. Y.

[2] With sheep.

Digestible Nutrients in a Ton (Pounds).

	Protein.	Fiber.	Nitrogen-free Extract.	Fat.	Total Organic Nutrients.
Blomo feed, ...	184	149	658	2	993
Oats for comparison, . . .	222	53	942	84	1,301
Corn meal for comparison, . .	164	-	1,348	69	1,581

It will be seen that the coefficients obtained from the Blomo are noticeably less than those from either corn or oats. The fat coefficient is of minor importance, because of the small quantity present. It is an established fact that horses digest less fiber than sheep, hence the digestion coefficient for the fiber in the Blomo feed, when applied to horses, is probably too high; a coefficient of 50 would be nearer correct.

Applying the digestion coefficients to the composition of the several feeds, and calculating the digestible organic nutrients in 1 ton, it becomes evident that the Blomo contains some 20 per cent. less digestible organic matter than oats, and some 35 per cent. less than corn. This is due to the comparatively undigestible character of the filler employed.

Cost of Digestible Matter in a Ton.

Allowing $32.50 a ton for Blomo ($1.30 an 80-pound bag), $31 a ton for oats (50 cents a bushel of 32 pounds), and $28 a ton for corn meal, the cost of a pound of digestible matter in each of the several feeds would be as follows: —

	Cents.
Blomo, ...	3.28
Oats, ...	2.40
Corn meal, ...	1.77

At the above prices, it will be seen that digestible matter costs nearly twice as much in the form of Blomo feed as when purchased in corn meal, and about one-third more than in the form of oats.

Feeding Trials with Horses.

Four horses belonging to the agricultural division of the station were employed for the purpose. These horses did hard farm work, which naturally varied somewhat in character and amount from time to time.

TRIAL I.

Object. — The object of the trial was to see if the horses would eat Blomo readily, maintain their weight, and keep in as good working condition as when fed their regular ration.

Rations fed. — The ordinary ration, previous to the beginning of the trial, consisted of 6 quarts of oats, 6 quarts of corn, and what hay the animals would eat clean. The trial ration consisted of 6 quarts of Blomo in place of 6 quarts of oats, 6 quarts of corn, and hay. The Blomo and oats should have been compared pound for pound, but through a misunderstanding they were fed quart for quart, so that 4.2 pounds of Blomo were fed against 6 pounds or more of oats.[1] The horses were gradually placed on the Blomo ration. Three ate it readily, while the fourth refused more or less of it at first, but eventually took the entire quantity without objection.

Duration of the Trial. — The trial began March 19 and lasted until July 5. During this time all four horses were kept constantly on the same ration, and in no case did they fail to take the full quantity of Blomo daily.

Weight and Condition of the Horses. — The horses were weighed two mornings weekly before being fed or watered.

Average Weight at Beginning and End of Trial (Pounds).

1904.	No. 1.	No. 2.	No. 3.	No. 4.
March 19,	1,248	1,288	1,368	1,195
July 5,	1,243	1,270	1,358	1,193

The weight varied slightly from week to week, but it is evident that the ration was sufficient to enable the animals to keep in good condition and do the work required.

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[1] Unfortunately, this department did not have the direct care of the animals, hence could not closely supervise the details of the trial.

While the trial was in progress it was found that the Blomo feed, which had been obtained directly from the manufacturers, was several per cent. below its protein guarantee. They claimed that this was due to carelessness on the part of their chemist, and forwarded another lot, with the request that it be used in place of the first shipment.

TRIAL II.

In the second trial the same horses were used.

Object of the Trial. — The object of the trial was to compare the Blomo feed with oats as a partial grain substitute for work horses.

Plan and Duration of the Trial. — The four horses were divided into lots of two each. In the first half of the trial horses Nos. 1 and 4 received the Blomo ration, and horses Nos. 2 and 3 the oat ration. In the second half these conditions were reversed. Each half lasted six weeks, as follows: —

	Blomo Ration.	Oat Ration.	Length (in Weeks).
July 18 through August 28,	Horses Nos. 1 and 4,	Horses Nos. 2 and 3,	6
September 5 through October 17,	Horses Nos. 2 and 3,	Horses Nos. 1 and 4,	6

Character of Rations. — The rations were in all cases measured out by the regular feeder. The same misunderstanding existed as in the former trial regarding the relative weight of the Blomo and oats, the feeder giving equal measure instead of weight of each. This resulted in the comparison of approximately 4.2 pounds of Blomo with 6 pounds of oats, which was manifestly unfair to the Blomo.

Blomo Ration fed daily.	*Oat Ration fed daily.*
6 quarts Blomo feed.	6 quarts oats.
6 quarts cracked corn.	6 quarts cracked corn.
Hay (judgment of feeder).	Hay (judgment of feeder).

Weights of Horses (Pounds).

HORSES.	BLOMO.			OATS.		
	Beginning.	End.	Gain or Loss.	Beginning.	End.	Gain or Loss.
No. 1,	1,230	1,245	15+	1,255	1,240	15—
No. 2,	1,295	1,350	55+	1,265	1,290	25+
No. 3,	1,390	1,370	20—	1,325	1,375	50+
No. 4,	1,180	1,205	25+	1,200	1,195	5—
Totals,	5,095	5,170	75+	5,045	5,100	55+

These horses made a slight gain in each case, indicating that both rations were rather more than sufficient to furnish the necessary nutrients for the work performed. Because of the uneven character of the work from day to day, it is not possible to say that one ration gave any better results than the other. It can simply be stated that the horses ate the Blomo ration readily, kept in good condition, and did satisfactory work during the trial.

Keeping Quality of Blomo.

The first lot, of 1 ton, obtained in March, contained 21.5 per cent. of moisture. It was fed gradually until late June, when 480 pounds, or about one-quarter, had spoiled. The second lot, of ½ ton, contained 20 per cent. of water, and was fed from early July until late October, during which time 450 pounds, or nearly one-half, had become sour. This lot underwent a slight decomposition during the warm, muggy weather of August and September. It will be quite necessary for the manufacturers to reduce the moisture content to 12 or less per cent., in order to prevent such changes, especially during the warm season.

Conclusions.

1. Blomo feed was eaten readily, excepting that one of the horses objected to it during the first week of the trial.

2. Considerable of the Blomo spoiled on being kept during the warm weather, and it will be necessary for the manufacturers to reduce the moisture content, in order to overcome this difficulty.

3. It contained noticeably less digestible matter than corn or oats, and, at prices usually prevailing, the nutritive matter it contains must be regarded as decidedly expensive.

4. No injurious effect was noted from feeding a considerable quantity of Blomo as a component of the daily ration during a period of seven months. The horses kept in good condition and did satisfactory work.

5. Owing to a misunderstanding, whereby the Blomo and oats were fed measure for measure, instead of weight for weight, it was not possible to directly compare the feeding value of these two feeds.

6. No particular advantage is to be gained from the use of Blomo feed, other than securing a change from the regular corn and oat diet.

REPORT OF THE CHEMIST.

DIVISION OF FERTILIZERS AND FERTILIZER MATERIALS.

CHARLES A. GOESSMANN.
Assistants: HENRI D. HASKINS, RICHARD H. ROBERTSON,[1] EDWARD G. PROULX.

PART I. — Report on Official Inspection of Commercial Fertilizers.
PART II. — Report on General Work in the Chemical Laboratory.

PART I. — REPORT ON OFFICIAL INSPECTION OF COMMERCIAL FERTILIZERS AND AGRICULTURAL CHEMICALS DURING THE SEASON OF 1904.

CHARLES A. GOESSMANN.

The total number of manufacturers, importers and dealers in commercial fertilizers and agricultural chemicals who have secured licenses during the past season is 66; of these, 38 have offices for the general distribution of their goods in Massachusetts, 8 in New York, 8 in Connecticut, 3 in Vermont, 2 in Pennsylvania, 2 in Ohio, 1 in Rhode Island, 1 in Canada, 1 in New Jersey, 1 in Maryland and 1 in Arkansas.

Three hundred and twenty-nine brands of fertilizers and agricultural chemicals have been licensed in Massachusetts during the year. Five hundred and seventy-six samples of fertilizers have been collected up to the present time, in our general markets by experienced assistants in the station. Five hundred and twenty-five samples were analyzed at the beginning of December, 1904, representing 295 distinct brands of fertilizers. These analyses were published in two bulletins of the Hatch Experiment Station of the Massachusetts Agricultural College: No. 100, July, and No. 102, November, 1904. Other official samples not included in these two bulletins will be reserved for our next publication in March, 1905. By comparing the above statements with those of our previous annual reports, it will be seen that there is a gradual increase in the number of fertilizers that are licensed in the State of Massachusetts from year to year. This fact would tend to show an increased consumption of these articles, and would emphasize the importance of their annual inspection from a commercial agricultural standpoint. Twenty-three more brands of fertilizers have been licensed during the past season than in the previous year.

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[1] Died Sept. 10, 1904.

The following table gives in compact form an abstract of the results of analyses of official commercial fertilizers: —

	1903.	1904.
(*a*) Where three essential elements of plant food were guaranteed: —		
Number with three elements equal to or above the highest guarantee,	7	7
Number with two elements above the highest guarantee, . . .	19	32
Number with one element above the highest guarantee, ...	91	111
Number with three elements between the lowest and highest guarantee,	207	190
Number with two elements between the lowest and highest guarantee,	118	146
Number with one element between the lowest and highest guarantee, .	42	48
Number with three elements below the lowest guarantee, . . .	2	none
Number with two elements below the lowest guarantee, ...	24	12
Number with one element below the lowest guarantee, ...	100	108
(*b*) Where two essential elements of plant food were guaranteed: —		
Number with two elements above the highest guarantee, . . .	2	8
Number with one element above the highest guarantee, ...	17	16
Number with two elements between the lowest and highest guarantee,	31	20
Number with one element between the lowest and highest guarantee, .	13	19
Number with two elements below the lowest guarantee, ...	1	1
Number with one element below the lowest guarantee, ...	14	15
(*c*) Where one essential element of plant food was guaranteed: —		
Number above the highest guarantee, ...	11	16
Number between the lowest and highest guarantee, ...	13	24
Number below the lowest guarantee, ...	18	13

From the above table it will be seen that, on the whole, the quality of the fertilizers that have been licensed, collected and examined during the past year is higher than in the previous season of 1903.

Trade Values of Fertilizing Ingredients in Raw Materials and Chemicals, 1903 and 1904 (Cents per Pound).

	1903.	1904.
Nitrogen in ammonia salts,	17.50	17.50
Nitrogen in nitrates,	15.00	16.00
Organic nitrogen in dry and fine-ground fish, meat, blood, and in high-grade mixed fertilizers.	17.00	17.50
Organic nitrogen in fine bone and tankage,	16.50	17.00
Organic nitrogen in medium bone and tankage,	12.00	12.50
Phosphoric acid soluble in water,	4.50	4.50
Phosphoric acid soluble in ammonium citrate,	4.00	4.00
Phosphoric acid in fine-ground fish, bone and tankage,	4.00	4.00
Phosphoric acid in cotton-seed meal, castor pumace and wood ashes,	4.00	4.00
Phosphoric acid in coarse fish, bone and tankage,	3.00	3.00
Phosphoric acid insoluble (in water and ammonium citrate) in mixed fertilizers.	2.00	2.00
Potash as sulfate (free from chloride),	5.00	5.00
Potash as muriate,	4.25	4.25

A comparison of the market costs of the different essential ingredients of plant food for 1904 with the previous year shows the following variation: nitrogen in the form of nitrates is a cent higher per pound; the higher grades of organic nitrogen, including nitrogen classed in high-grade mixed fertilizers, are half a cent higher in cost than for the year 1903; the cost of the different forms of phosphoric acid and potassium oxide remains the same as in the previous year.

As in the past, the above schedule of trade values was adopted by representatives of the Massachusetts, Connecticut, Rhode Island, Maine, Vermont and New Jersey experiment stations, at a conference held during the month of March, 1904, and is based upon the quotations in ton lots of the leading standard raw materials furnishing nitrogen, phosphoric acid and potash, and which go to make up the bulk of our commercial fertilizers. These quotations are taken from the fertilizer markets in centres of distribution in New England, New York and New Jersey during the six months preceding March, 1904.

Table A, on the following page, gives the average analysis of officially collected fertilizers for 1904; Table B gives a compilation of analyses, showing the maximum, minimum and average percentages of the different essential ingredients of plant food found in the special crop fertilizers, so called, put out by the different manufacturers during the season of 1904.

TABLE A. — *Average Analysis of Officially Collected Fertilizers for 1904 (Per Cent.).*

NATURE OF MATERIAL.	Moisture.	NITROGEN IN ONE HUNDRED POUNDS.		PHOSPHORIC ACID IN ONE HUNDRED POUNDS.							POTASSIUM OXIDE IN ONE HUNDRED POUNDS.	
							TOTAL.		AVAILABLE.			
		Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
Complete fertilizers,	10.67	2.96	2.73	4.30	3.66	2.87	10.60	9.11	7.89	7.55	5.47	5.22
Ground bones,	8.70	3.32	2.98	.42	7.37	16.12	23.91	22.24	7.80	8.39	-	-
Tankage,	10.39	7.02	5.49	-	5.11	5.10	10.21	15.20	5.26	-	-	-
Dry ground fish,	9.82	8.44	8.19	-	5.08	3.76	8.84	7.20	5.08	-	-	-
Dissolved bone-black,	10.92	-	-	12.81	3.00	1.70	17.51	15.50	15.81	15.00	-	-
Acid phosphate,	10.92	-	-	10.33	4.46	1.69	16.48	13.90	14.79	12.33	-	-
Wood ashes,	15.98	-	-	-	-	-	1.52	1.10	-	-	4.59	4.83
Cotton-seed meal,	7.44	6.79	7.00	-	-	-	-	-	-	-	-	-
Flax meal,	8.84	5.89	6.08	-	-	-	-	-	-	-	-	-
Nitrate of soda,	1.76	15.34	15.43	-	-	-	-	-	-	-	-	-
Sulfate of ammonia,	.18	20.20	19.00	-	-	-	-	-	-	-	-	-
High-grade sulfate of potash,	.49	-	-	-	-	-	-	-	-	-	49.65	48.00
Muriate of potash,	1.47	-	-	-	-	-	-	-	-	-	50.69	50.00
Dried blood,	15.13	10.80	6.78	-	-	-	-	-	-	-	-	-

TABLE B. — *Compilation of Analyses of Commercial Fertilizers for the Year 1904 (Per Cent.).*

NAME OF FERTILIZER.	Moisture.	NITROGEN IN ONE HUNDRED POUNDS.			TOTAL PHOSPHORIC ACID IN ONE HUNDRED POUNDS.			AVAILABLE PHOSPHORIC ACID IN ONE HUNDRED POUNDS.			POTASSIUM OXIDE IN ONE HUNDRED POUNDS.		
		Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.
Corn fertilizer,	11.33	5.33	1.12	2.84	14.82	8.72	11.03	10.76	5.36	8.44	8.96	1.54	3.58
Fruit and vine fertilizer,	11.29	3.36	2.46	3.02	13.02	7.82	9.58	9.26	7.06	7.23	11.06	5.62	8.42
Grain fertilizer,	9.67	7.81	.84	2.65	11.06	8.12	9.77	9.01	4.37	6.56	10.40	.88	3.82
Grass fertilizer,	7.83	5.31	2.49	4.06	14.71	5.06	9.14	13.03	2.68	6.81	11.94	2.20	5.33
Market-garden fertilizer,	11.53	4.09	1.73	2.87	11.54	8.65	10.56	9.09	6.91	8.18	10.00	2.06	6.18
Potato fertilizer,	11.38	4.63	1.71	2.63	14.44	6.93	10.27	12.58	4.12	8.06	10.06	2.58	5.64
Tobacco fertilizer,	10.14	5.97	.66	4.04	14.96	5.50	10.20	11.42	1.76	6.59	15.06	.72	8.13
Onion fertilizer,	10.95	3.42	1.61	3.02	12.18	8.24	9.88	8.93	6.84	7.97	10.48	6.78	7.78

A study of Table B teaches the same lessons as in the past. It is a much safer plan to study our fertilizer bulletins, when selecting a supply of commercial fertilizers, than to depend upon mere trade names. Oftentimes the fertilizer costing the most per ton is the cheapest and most economical fertilizer to use if applied to the soil intelligently. Every farmer should know the requirements of his soil, in order to judiciously select his supply of fertilizers. No iron-clad rule can be laid down for selecting fertilizers, as conditions vary so widely on different soils; it is safe to say, however, that for general use those fertilizers should be purchased which furnish the greatest amount of the three essential elements of plant food in a suitable and available form for the same money.

List of Manufacturers and Dealers who have secured Certificates for the Sale of Commercial Fertilizers in the State during the Past Year (May 1, 1904, to May 1, 1905), and the Brands licensed by Each.

The American Agricultural Chemical Co., Boston, Mass.: —
- Brightman's Fish and Potash.
- Double Manure Salt.
- Dissolved Bone-black.
- Dried Blood.
- Dry Ground Fish.
- Fine-ground Bone.
- Fine-ground Tankage.
- Grass and Lawn Top-dressing.
- Ground South Carolina Phosphate.
- High-grade Fertilizer with Ten Per Cent. Potash.
- High-grade Sulfate of Potash.
- Kainit.
- Muriate of Potash.
- Nitrate of Soda.
- Plain Superphosphate.
- Tobacco Starter and Grower.

The American Agricultural Chemical Co. (Bradley Fertilizer Co., branch), Boston, Mass.: —
- Abattoir Bone Dust.
- Bradley's Complete Manure for Corn and Grain.
- Bradley's Complete Manure for Onions.
- Bradley's Complete Manure for Potatoes and Vegetables.
- Bradley's Complete Manure for Top-dressing Grass and Grain.
- Bradley's Complete Manure with Ten Per Cent. Potash.
- Bradley's Corn Phosphate.
- Bradley's Eclipse Phosphate.

The American Agricultural Chemical Co. (Bradley Fertilizer Co., branch), Boston, Mass. — *Con.*
- Bradley's English Lawn Fertilizer.
- Bradley's Niagara Phosphate.
- Bradley's Potato Fertilizer.
- Bradley's Potato Manure.
- Bradley's Seeding-down Manure.
- Bradley's X L Superphosphate.
- Columbia Fish and Potash.
- Church's Fish and Potash.

The American Agricultural Chemical Co. (H. J. Baker & Bro., branch), New York, N. Y.: —
- Baker's A A Ammoniated Phosphate.
- Baker's Complete Potato Manure.

The American Agricultural Chemical Co. (Clark's Cove Fertilizer Co., branch), Boston, Mass.: —
- Clark's Cove Bay State Fertilizer.
- Clark's Cove Bay State Fertilizer, G G.
- Clark's Cove Great Planet Manure.
- Clark's Cove King Philip Guano.
- Clark's Cove Potato Fertilizer.
- Clark's Cove Potato Manure.

The American Agricultural Chemical Co. (Crocker Fertilizer and Chemical Co., branch), Buffalo, N. Y.: —
- Crocker's A A Complete Manure.
- Crocker's Corn Phosphate.
- Crocker's Potato, Hop and Tobacco Phosphate.

The American Agricultural Chemical Co. (Cumberland Bone Phosphate Co., branch), Boston, Mass.: —
- Cumberland Potato Fertilizer.
- Cumberland Superphosphate.

The American Agricultural Chemical Co. (L. B. Darling Fertilizer Co., branch), Pawtucket, R. I.: —
- Darling's Blood, Bone and Potash.
- Darling's Complete Ten Per Cent. Manure.
- Darling's Farm Favorite.
- Darling's General Fertilizer.
- Darling's Potato and Root Crop Manure.
- Darling's Potato Manure.
- Darling's Tobacco Grower.

The American Agricultural Chemical Co. (Great Eastern Fertilizer Co., branch), Rutland, Vt.: —
- Garden Special.
- General Fertilizer.
- Grass and Oats Fertilizer.
- Northern Corn Special.
- Vegetable, Vine and Tobacco.

The American Agricultural Chemical Co. (Pacific Guano Co., branch), Boston, Mass.: —
- Pacific High-grade General.
- Pacific Nobsque Guano.
- Pacific Potato Special.
- Soluble Pacific Guano.

The American Agricultural Chemical Co. (Packers' Union Fertilizer Co., branch), Rutland, Vt.: —
- Animal Corn Fertilizer.
- Gardener's Complete Manure.
- Potato Manure.
- Universal Fertilizer.
- Wheat, Oats and Clover Fertilizer.

The American Agricultural Chemical Co. (Quinnipiac Co., branch), Boston, Mass.: —
- Quinnipiac Climax Phosphate.
- Quinnipiac Corn Manure.
- Quinnipiac Havana Tobacco Fertilizer.
- Quinnipiac Market-garden Manure.
- Quinnipiac Onion Manure.
- Quinnipiac Phosphate.
- Quinnipiac Potato Manure.
- Quinnipiac Potato Phosphate.

The American Agricultural Chemical Co. (Read Fertilizer Co., branch), New York, N. Y.: —
- Read's Farmers' Friend.
- Read's High-grade Farmers' Friend.
- Read's Practical Potato Special.
- Read's Standard.
- Read's Vegetable and Vine.

The American Agricultural Chemical Co. (Standard Fertilizer Co., branch), Boston, Mass.: —
- Standard Complete Manure.
- Standard Fertilizer.
- Standard Guano.
- Standard Special for Potatoes.

The American Agricultural Chemical Co. (Henry F. Tucker Co., branch), Boston, Mass.: —
- Tucker's Original Bay State Bone Superphosphate.
- Tucker's Special Potato Fertilizer.

The American Agricultural Chemical Co. (Williams & Clark Fertilizer Co., branch), Boston, Mass: —
- Williams & Clark's Americus Phosphate.
- Williams & Clark's Corn Phosphate.
- Williams & Clark's High-grade Special.
- Williams & Clark's Potato Manure.
- Williams & Clark's Potato Phosphate.
- Williams & Clark's Prolific Crop Producer.
- Williams & Clark's Royal Bone Phosphate.

The American Agricultural Chemical Co. (M. E. Wheeler & Co., branch), Rutland, Vt.: —
- Corn Fertilizer.
- Bermuda Onion Grower.
- Grass and Oats Fertilizer.
- Havana Tobacco Fertilizer.
- Potato Manure.

W. H. Abbott, Holyoke, Mass.: —
- Animal Fertilizer.
- Eagle Brand.
- Tobacco Fertilizer.

The Abbott & Martin Rendering Co., Columbus, O.: —
- Abbott's Tobacco and Potato Special.
- Harvest King.
- Ideal Grain Grower.

The American Cotton Oil Co., New York, N. Y.: —
- Cotton-seed Meal.
- Cotton-seed Hull Ashes.

American Linseed Co., New York, N. Y.: —
- Cleveland Flax Meal.

Armour Fertilizer Works, Baltimore, Md.: —
- All Soluble.
- Ammoniated Bone with Potash.
- Bone Meal.
- Blood, Bone and Potash.
- Grain Grower.
- High-grade Potato.

H. J. Baker and Bro., New York, N Y.: —
Castor Pumace.

Beach Soap Co., Lawrence, Mass.: —
Beach's Advance Brand.
Beach's Fertilizer Bone.
Beach's Reliance.
Beach's Universal.

Berkshire Fertilizer Co., Bridgeport, Conn.: —
Berkshire Complete Fertilizer.
Berkshire Ammoniated Bone Phosphate.
Berkshire Potato and Vegetable Phosphate.

Joseph Breck & Sons, Boston, Mass.: —
Breck's Lawn and Garden Dressing.
Breck's Market-garden Manure.

Bowker Fertilizer Co., Boston, Mass.: —
Bone, Blood and Potash.
Bowker's Ammoniated Food for Flowers.
Bowker's Bone and Wood Ash Fertilizer.
Bowker's Complete Mixture.
Bowker's Double Manure Salts.
Bowker's Farm and Garden Phosphate.
Bowker's Fish and Potash (Square Brand).
Bowker's Ground Bone.
Bowker's High-grade Fertilizer.
Bowker's Hill and Drill Phosphate.
Bowker's Kainit.
Bowker's Lawn and Garden Dressing.
Bowker's Potato and Vegetable Fertilizer.
Bowker's Potash Bone.
Bowker's Market-garden Fertilizer.
Bowker's Potato and Vegetable Phosphate.
Bowker's Soluble Animal Fertilizer.
Bowker's Special Onion Manure.
Bowker's Superphosphate.
Bowker's Sure Crop Phosphate.
Bowker's Tankage.
Bowker's Ten Per Cent. Manure.
Bowker's Tobacco Ash Fertilizer.
Bowker's Tobacco Starter.
Bristol Fish and Potash.
Corn Phosphate.
Dissolved Bone-black.
Dried Blood.
Early Potato Manure.
Fine Dry Ground Fish.
Fish and Potash (D Brand).
Gloucester Fish and Potash.
Muriate of Potash.
Nitrate of Soda.
Stockbridge Special Manures.
Sulfate of Ammonia.

Bowker Fertilizer Co., Boston, Mass. — *Con.*
Sulfate of Potash.
Tobacco Ash Elements.
Wood Ashes.

T. H. Bunch, Little Rock, Ark.: —
Cotton-seed Meal.

Charles M. Cox & Co., Boston, Mass.: —
Cotton-seed Meal.

Chicopee Rendering Co., Springfield, Mass.: —
Pure Ground Bone.
Complete Animal Fertilizer.
Lawn and Garden Dressing.
Tankage.

E. Frank Coe Co., New York, N. Y.: —
American Farmers' Ammoniated Bone.
American Farmers' Complete Manure.
American Farmers' Corn King.
American Farmers' Grass and Grain.
American Farmers' Market-garden Special.
Columbian Corn Fertilizer.
Columbian Potato Fertilizer.
E. Frank Coe's F P Fish and Potash.
E. Frank Coe's Gold Brand Excelsior Guano.
E. Frank Coe's High-grade Ammoniated Bone Superphosphate.
E. Frank Coe's Nitrate of Soda.
E. Frank Coe's Tobacco and Onion Fertilizer.
Celebrated Special Potato.
Excelsior Potato Fertilizer.
New Englander Corn Fertilizer.
New Englander Potato Fertilizer.
Red Brand Excelsior Guano.
X X X Ground Bone.

John C. Dow & Co., Boston, Mass.: —
Dow's Pure Ground Bone.

Eastern Chemical Co., Boston, Mass.: —
Imperial Grass Fertilizer.
Imperial Plant Food.

William E. Fyfe & Co., Clinton, Mass.: —
Canada Unleached Hard-wood Ashes.

R. & J. Farquhar & Co., Boston, Mass.: —
Clay's London Fertilizer.
Thompson's Improved Vine, Plant and Vegetable Manure.

Hargraves Soap Co., Fall River, Mass.: —
Ground Bone Fertilizer.

The Hardy Packing Co., Columbus, O.: —
Hardy's Complete Manure.
Hardy's Tankage, Bone and Potash.
Hardy's Tobacco and Potato Special.

C. W. Hastings, Cambridgeport, Mass.: —
Ferti Flora.

Thomas Hersom & Co., New Bedford, Mass.: —
Bone Meal.
Meat and Bone.

John Joynt, Lucknow, Can.: —
Pure Canada Unleached Hard-wood Ashes.

Lister's Agricultural Chemical Works, Newark, N. J.: —
Lister's Animal Bone and Potash.
Lister's High-grade Special.
Lister's Oneida Special.
Lister's Potato Manure.
Lister's Special Corn.
Lister's Special Potato.
Lister's Success Fertilizer.

Lowell Fertilizer Co., Boston, Mass.: —
Acid Phosphate.
Muriate of Potash.
Nitrate of Soda.
Swift's Lowell Animal Brand.
Swift's Lowell Bone Fertilizer.
Swift's Lowell Dissolved Bone and Potash.
Swift's Lowell Dissolved Bone-black.
Swift's Lowell Empress Brand.
Swift's Lowell Ground Bone.
Swift's Lowell Lawn Dressing.
Swift's Lowell Market Garden.
Swift's Lowell Potato Manure.
Swift's Lowell Potato Phosphate.
Swift's Lowell Tankage.

George E. Marsh & Co., Lynn, Mass.: —
Pure Bone Meal.

Mapes Formula and Peruvian Guano Co., New York, N. Y.: —
Average Soil Complete Manure.
Cauliflower and Cabbage Manure.
Complete Manure (A Brand).
Complete Manure for General Use.
Complete Manure Ten Per Cent. Potash.
Corn Manure.
Economical Potato Manure.
Fruit and Vine Manure.
Grass and Grain Spring Top-dressing.
Lawn Top-dressing.
Potato Manure.
Tobacco Ash Constituents.
Tobacco Manure Wrapper Brand.
Tobacco Starter Improved.
Top-dressing Improved, One-half Strength.
Vegetable Manure or Complete Manure for Light Soils.

D. M. Moulton, Monson, Mass.: —
Ground Bone.

National Fertilizer Co., Bridgeport, Conn.: —
Chittenden's Ammoniated Bone.
Chittenden's Complete Fertilizer.
Chittenden's Fish and Potash.
Chittenden's High-grade Special.
Chittenden's Market Garden.
Chittenden's Potato Phosphate.
Chittenden's Tobacco Manure.

New England Fertilizer Co., Boston, Mass.: —
Corn Phosphate.
Potato Fertilizer.
Superphosphate.

Olds & Whipple, Hartford, Conn.: —
Complete Tobacco Fertilizer.
Vegetable Potash.

R. T. Prentiss, Holyoke, Mass.: —
Complete Fertilizer.

Parmenter & Polsey Fertilizer Co., Peabody, Mass.: —
A A Brand.
Acid Phosphate.
Lawn Dressing.
Grain Grower.
Muriate of Potash.
Nitrate of Soda.
P. & P. Potato.
Plymouth Rock Brand.
Special Fertilizer for Strawberries.
Special Potato.
Sulfate of Potash.

Jacob Reese, Darby, Penn.: —
Odorless Slag Phosphate.

Rogers & Hubbard Co., Middletown, Conn.: —
Hubbard's All Soils and All Crops Fertilizer.
Hubbard's Corn Phosphate.
Hubbard's Grass and Grain Fertilizer.
Hubbard's Oats and Top-dressing.
Hubbard's Potato Phosphate.
Hubbard's Pure Raw Knuckle Bone Flour.
Hubbard's Soluble Corn.
Hubbard's Soluble Potato Manure.
Hubbard's Soluble Tobacco Manure.
Hubbard's Strictly Pure Fine Bone.

Rogers Manufacturing Co., Rockfall, Conn.: —
All Round Fertilizer.
Complete Corn and Onion.
Complete Fish and Potash.

Rogers Manufacturing Co., Rockfall, Conn. — *Con.*
- Complete Potato and Vegetable.
- High-grade Grass and Grain.
- High-grade Oats and Top-dressing.
- High-grade Tobacco and Potato.
- High-grade Soluble Tobacco.
- Nitrate of Soda.
- Pure Fine-ground Bone.

Ross Bros., Worcester, Mass.: —
- Ross Brother's Lawn Dressing.

N. Roy & Son, South Attleborough, Mass.: —
- Complete Animal Fertilizer.

Russia Cement Co., Gloucester, Mass.: —
- Essex Complete Manure for Corn, Grain and Grass.
- Essex Complete Manure for Potatoes, Roots and Vegetables.
- Essex Corn Fertilizer.
- Essex Dry Ground Fish.
- Essex A I Superphosphate.
- Essex Market Garden and Potato Manure.
- Essex Odorless Lawn Dressing.
- Essex Rhode Island Special for Potatoes and Roots.
- Essex Special Tobacco Manure.
- Essex Tobacco Starter.
- Essex X X X Fish and Potash.
- Muriate of Potash.
- Nitrate of Soda.

Salisbury Cutlery Handle Co., Salisbury, Conn.: —
- Fine Bone.

M. L. Shoemaker & Co., Limited, Philadelphia, Penn.: —
- Swift Sure Superphosphate for General Use.
- Swift Sure Bone Meal.

Sanderson's Fertilizer and Chemical Co., New Haven, Conn.: —
- Sanderson's Corn Superphosphate.
- Sanderson's Fine-ground Fish.
- Sanderson's Formula A.
- Sanderson's Formula B.
- Sanderson's Sulfate of Potash.
- Sanderson's Potato Manure.
- Sanderson's Special with Ten Per Cent. Potash.
- Sanderson's Top-dressing for Grass and Grain.

Thomas L. Stetson, Randolph, Mass.: —
- Bone Meal.

J. Stroup, Son & Co., Boston, Mass.: —
- Canada Hard-wood Unleached Ashes.

A. L. Warren, Northborough, Mass.: —
- Warren's Ground Bone.

The Whitman & Pratt Rendering Co., Lowell, Mass.: —
- Whitman & Pratt's All Crops.
- Whitman & Pratt's Corn Success.
- Whitman & Pratt's Potato Plowman.
- Whitman & Pratt's Pure Ground Bone.

Wilcox Fertilizer Works, Mystic, Conn.: —
- Complete Bone Superphosphate.
- Dry Ground Fish.
- Fish and Potash.
- High-grade Tobacco Special.
- Potato Fertilizer.
- Potato, Onion and Vegetable.

Sanford Winter, Brockton, Mass.: —
- Pure Fine-ground Bone.

J. M. Woodard & Bro., Greenfield, Mass.: —
- Tankage.

A. H. Wood & Co., Framingham, Mass.: —
- A A Brand.
- B B Brand.
- C C Brand.

PART II. — REPORT ON GENERAL WORK IN THE CHEMICAL LABORATORY.

C. A. GOESSMANN.

1. Analyses of materials forwarded for examination.
2. Notes on wood ashes and lime ashes.
3. Notes on phosphatic slag and experiments with native phosphates.

1. ANALYSES OF MATERIALS FORWARDED FOR EXAMINATION.

This department of our work has been of the same general character as in past years. We have received during the season 283 samples of miscellaneous substances from farmers within our State for analysis; this is 48 more than was received during the season of 1903.

As far as time and facilities permit, we have devoted our attention to the examination of this class of materials, the substances being taken up for analysis in the order of their arrival at this office. During the season of the official inspection of commercial fertilizers, April 1 to November, our time is so completely occupied that work in this class of general materials, for the benefit of individual farmers, has to give place, in a measure, to the control work of inspection. For this reason we would urge those sending samples for free analysis to forward them, so far as possible, between November 1 and April 1, thus insuring more prompt reports in results of analysis.

As in the past, we have taken an active part in the technical work of the Association of Official Agricultural Chemists for the establishment of new methods of analysis. Many determinations were made on samples forwarded by the association to test the efficacy of several new methods of determining potash and the various forms of phosphoric acid.

Following is a list of materials forwarded by farmers and agricultural organizations during the season of 1904 : —

Wood ashes,	50	Steamed bone,	2
Soils,	47	Wool dust,	2
Complete fertilizers,	32	Wool waste,	2
Lime ashes,	14	Dried blood,	2
Tankage,	10	Sewage,	2
Ground bone,	9	Pulp ashes,	1
Nitrate of soda,	8	Cotton compost,	1
Miscellaneous substances,	9	Carbonate of potash-magnesia,	1
Low-grade sulfate of potash,	7	Silicate of potash,	1
Muck,	7	High-grade sulfate of potash,	1
Meadow mud,	7	Nitrate of potash,	1
Cotton-seed meal,	6	Belgian phosphate,	1
Dry ground fish,	5	Raw bone,	1
Mill refuse,	5	Dissolved bone,	1
Manure,	5	Lime and nitrate of soda,	1
Acid phosphate,	4	Guinea pig manure,	1
Peat,	4	Liquid manure,	1
Cotton-hull ashes,	3	Sheep manure,	1
Muriate of potash,	3	Lime refuse from tannery,	1
Lime,	3	Waste lime,	1
Dissolved bone-black,	3	Granulated lime,	1
Cotton-seed droppings,	2	Plaster,	1
Cotton-seed dust,	2	Raw hide dust,	1
Sulfate of ammonia,	2	Cocoa shells,	1
Carbonate of potash,	2	Dandelion roots,	1
Phosphatic slag,	2	Clover roots,	1

2. NOTES ON WOOD ASHES AND LIME ASHES.

(*a*) *Wood Ashes.* — Seventeen and one-half per cent. of the materials forwarded for analysis during the season have been wood ashes, being about the same proportion as that for the year 1903. The following abstract of results of analysis shows their general chemical character, also a comparison in results of analysis with the previous year 1903 : —

Analysis of Wood Ashes.

	NUMBER OF SAMPLES.	
	1903.	1904.
Moisture from 1 to 10 per cent.,	11	18
Moisture from 10 to 20 per cent.,	14	16
Moisture from 20 to 30 per cent.,	9	8
Moisture above 30 per cent.,	3	3
Potassium oxide above 8 per cent.,	2	2
Potassium oxide from 6 to 7 per cent.,	4	8
Potassium oxide from 5 to 6 per cent.,	8	6
Potassium oxide from 4 to 5 per cent.,	12	12
Potassium oxide from 3 to 4 per cent.,	8	10
Potassium oxide below 3 per cent.,	3	7
Phosphoric acid from 1 to 2 per cent.,	34	30
Phosphoric acid above 2 per cent.,	none	3
Phosphoric acid below 1 per cent.,	3	12
Average per cent. of calcium oxide (lime),	29.39	30.16
Insoluble matter below 10 per cent.,	7	6
Insoluble matter from 10 to 15 per cent.,	12	18
Insoluble matter above 15 per cent.,	17	20

Table showing the Maximum, Minimum and Average Per Cents. of the Different Ingredients found in Wood Ashes for the Seasons of 1903 and 1904.

	MAXIMUM.		MINIMUM.		AVERAGE.	
	1903.	1904.	1903.	1904.	1903.	1904.
Moisture,	37.34	37.85	2.27	none	15.23	14.42
Potassium oxide,	8.15	11.04	1.68	.80	4.76	4.51
Phosphoric acid,	1.80	6.07	.46	.28	1.37	1.37
Calcium oxide,	35.75	42.86	22.33	19.73	29.39	30.16
Insoluble matter,	28.85	47.21	1.40	4.56	15.07	18.35

From the above tables it will be seen that the percentage of potassium oxide in the wood ashes received during the season is, on the average, somewhat less than for the previous season. The average of phosphoric acid is the same; while the average percentage of lime is somewhat higher than for 1903.

A study of these tables will emphasize the importance of buying this class of material on a statement of a guaranteed composition. We would urge all parties to ask for a positive guarantee of the amount of potassium oxide, phosphoric acid and calcium oxide (although our State law does not oblige the manufacturer to guarantee the latter element, it should be required when buying this class of fertilizers) said to be contained in this or similar classes of fertilizers. We would also advise all parties to patronize those dealers and importers who have complied with our State laws by securing a license for the sale of their article in Massachusetts. It is only in this way that protection by our State laws can be secured.

(*b*) *Lime Ashes.* — What has been said regarding wood ashes applies with equal force to lime ashes. They should always be bought on a statement of the guarantee of lime, potash and phosphoric acid which they contain, as they are more apt to vary widely in chemical composition than even wood ashes.

Table showing the Maximum, Minimum and Average Per Cents. of the Different Ingredients found in Lime Ashes for the Seasons of 1903 and 1904.

	MAXIMUM.		MINIMUM.		AVERAGE.	
	1903.	1904.	1903.	1904.	1903.	1904.
Moisture,	23.16	36.62	10.47	none	15.66	10.88
Potassium oxide,	8.32	2.46	.76	.06	1.86	1.54
Phosphoric acid,	1.66	1.48	.03	trace	.63	.74
Calcium oxide,	55.44	55.24	32.42	21.92	41.15	42.98
Insoluble matter,	26.50	25.47	1.10	2.76	6.46	8.11

From the above comparison it will be seen that the lime ashes during the present season analyzed a little higher in lime and a little lower in potash than in 1903.

3. NOTES ON PHOSPHATIC SLAG AND EXPERIMENTS WITH NATIVE PHOSPHATES.

In one of our previous annual reports (thirteenth annual report, 1901, of Hatch Experiment Station of Massachusetts Agricultural College, pp. 68–70) we have discussed in detail the history and timely appearance of the basic slag phosphate in our general markets. In this article we pointed out the special modes of analysis that were in use in testing this material, also certain changes that have taken place in many localities in preparing the phosphatic slag by the addition of silica in a fusing process to change the free lime which is present in the slag to a silicate of lime, thus showing, it is claimed, a larger percentage of available phosphoric acid.

Samples of phosphatic slag have been collected in our general markets during the past year. This would indicate that this class of material was claiming the attention of agriculturists more than in the past. The extensive introduction of new methods of iron manufacture has largely increased the supply of phosphatic slag. Results of field experiments have shown the superior value of this material and demonstrated its fitness as a manurial matter. In view of the above facts, we have again taken this subject up for discussion.

The following table gives the results of analysis of samples of phosphatic slag made at the laboratory during 1904, in comparison with the average of analyses of slags made at the station in years past. Sample I. was imported from England in 1904; Sample II. was collected in our general markets during the spring of 1904; Sample III. was the average of all previous analyses made at the station.

Analysis of Samples (Per Cent.).

	Sample I.	Sample II.	Sample III.
Moisture, ...	.15	none	.99
Total phosphoric acid, ...	18.61	20.52	20.61
Available phosphoric acid, ...	-	4.96	4.05
Insoluble phosphoric acid, ...	-	15.56	19.02
Calcium oxide, ...	50.58	46.78	50.32
Insoluble matter, ...	-	18.78	6.59

From the results of the above compilation of analyses it will be seen that the present phosphatic slag does not differ materially from that of the past. The two samples analyzed during the year showed the presence of free lime, which fact was recognized and the mode of analysis was so modified as to counteract the action of the free lime before subjecting the samples to the usual treatment with neutral citrate of ammonia for the dermination of the available phosphoric acid.

The attempt to imitate the phosphatic slag, by fusing apatite with soda ash at 600° to 800° C., was mentioned in our previous annual report. Observations have been extended along this line during recent years by fusing natural phosphates with carnallite and kieserite for ten to fifteen minutes, at a temperature of 650° to 800° C. This treatment gave a compound analyzing: —

	Per Cent.
Total phosphoric acid,	20.71
Phosphoric acid soluble in 2 per cent. citric acid solution,	15.23
Calcium oxide,	9.92
Magnesium oxide,	10.20
Potassium oxide,	6.85
Chlorine,	16.47

It was reported that the effect of this fertilizer on oats and peas was somewhat superior to phosphatic slag, as regards the yield of grain.

Another substitute for slag phosphate is described by Prof. P. Wagner: 100 parts of coarsely crushed phosphorite is fused with 70 parts of acid sodium sulfate; 20 parts of calcium carbonate, 22 parts of sand and 6 to 7 parts of coal; this gave a product testing 15.7 per cent. phosphoric acid, practically all of which was soluble in citric acid solution. Pot experiments were conducted on oats, grown on loam soil, by the aid of this mixture, alongside of similar experiments conducted with a superphosphate testing 17.7 per cent. water-soluble phosphoric acid and 18.9 per cent. total phosphoric acid and phosphatic slag, testing 18 per cent. citric acid soluble phosphoric and 19.9 per cent. total phosphoric acid. The fused mixture gave as quick-acting and effective results as the superphosphate, and also gave results superior to the basic slag phosphate.

During the winter of 1902 Mr. H. D. Haskins of this department made some interesting experiments in fusing Canadian apatite with a mixture of sodium and potassium carbonates. The apatite was a high-grade material, testing

31.22 per cent. phosphoric acid and 51.74 per cent. calcium oxide. His experiments were conducted as follows: 1 part of the apatite was fused with 4 parts of a mixture composed of 23 parts of sodium carbonate and 39 parts of potassium carbonate. The resulting mass was extracted with water, and showed a test of 3.68 per cent. water-soluble phosphoric acid. The residue, upon treatment with neutral citrate of ammonia, showed a test of 26.78 per cent. of reverted phosphoric acid, leaving only .76 per cent. of phosphoric acid in an insoluble form. In another experiment 1 part of the apatite was fused with 1.15 parts of the same fusing mixture, this amount of sodium and potassium carbonate being theoretically necessary to convert all of the phosphoric acid into phosphates of soda and potash. The resulting mass showed 2.56 per cent. of water-soluble phosphoric acid, 15.96 per cent. of reverted phosphoric acid and 12.70 per cent. of insoluble phosphoric acid. Mr. Haskins also made experiments to ascertain to what extent the phosphoric acid in apatite would become available if boiled with a solution of sodium and potassium carbonate. Several strengths of solution were used, but only traces of phosphoric acid were dissolved, the residue in no case showing over 1.98 per cent. available phosphoric acid. From the above observations it will appear that great fields are opened for a more extensive use of our natural phosphates when introduced in a suitable form by some fusing process.

In conclusion, we must say that the consumption of commercial fertilizers is ever on the increase, and it is a great satisfaction to feel that apparently the increased consumption of fertilizers is more than off-set by the prospective increase in natural supplies. The increased production of sulfate of ammonia from improved methods in the manufacture of coke from bituminous coal, the recent discoveries of new potash deposits in Saxony, Ger., as well as the recent reported discovery of nitrate of soda beds along the Pacific coast in the United States, all furnish pleasant reflections for the future of American agriculture.

REPORT OF THE ENTOMOLOGISTS.

C. H. FERNALD, H. T. FERNALD.

A number of different lines of investigation have been begun or continued during the year 1904, in addition to what may be termed the routine work of the division.

Experiments to determine the best treatment for the San José scale, begun at this station in 1902, have been concluded, at least for the present, as they have resulted in so thoroughly freeing the college orchard from this pest as to leave no material for further experiment. It is true that the scale is not exterminated, but it is present in such small numbers that several years must elapse before the orchard will become so reinfested as to be of any value for experimental purposes. On the other hand, it is impossible under present conditions to attempt experimental work elsewhere, and therefore this line of research is at least temporarily suspended.

A number of private preparations claiming to be useful as insecticides have been tested during the year, with varying results ; but none have thus far been found which appear to be of great value. Whether it is worth while to take the large amount of time necessary for these tests, when the results, if they should ever by any chance prove valuable, would practically only produce free advertising to those manufacturing them, is certainly questionable, particularly as scarcely any of these substances are made by residents of this State.

The codling moth is now treated by spraying during the egg-laying period of this insect. In the west there are several broods of this pest each year, but in Massachusetts there seems to be much uncertainty on this point. For two years observations have been conducted to determine the number of broods of this insect, and the proper times at which to spray the trees in order to obtain the best results. The difference in seasons is of course a factor in the determination of these points, and renders it necessary that the work be continued for a term of years before final results can be obtained.

The oyster-shell scale can easily be controlled by mild sprays if these are applied at the right times, but two years ago no one in Massachusetts seemed to know just that time. In States but a short distance south this pest has two broods, and it has been doubtful whether there were not two here also. In order to determine these questions, careful observations have been made during the last two years, and must be continued for several more in order to obtain reliable results.

For nearly three months of the year all the spare time of the entomologists was devoted to the preparation of an exhibit for the Louisiana Purchase Exposition, taking time which could otherwise have been devoted to experimental work. The nature and scope of this exhibit has been presented elsewhere, and need not be given here.

During the colder months of the year experimental work is practically impossible, and this time is made use of in putting together the results of previous investigations, and drawing conclusions from them; in classifying and arranging the materials gathered and received during the summer; in solving the more complex problems connected with cases of injury difficult to reach and control by ordinary means; and in original investigations of various kinds.

The correspondence with residents of the State requires a large amount of time. In 1903 this was less than usual, the reasons for it being considered in the last report. This year it has resumed its normal quantity, about 1,500 inquiries having been received and answered by letter, or by sending printed information on the topics concerned.

Particular effort has been made to obtain samples of the injuries caused by insects, these being often markedly characteristic, and therefore of the greatest utility in a collection so constantly referred to.

The card catalogue has now been installed in a new case, capable of holding 90,000 cards, and is in constant use; in fact, it is probably the most useful single piece of apparatus in the possession of the division. Additional cards are constantly being added as new literature is published.

INSECTS OF THE YEAR.

The unusually cold weather during the winter of 1903–04, together with a few sudden and marked fluctuations of the temperature, was not without its effect upon insect life, as was shown last summer, though perhaps less than might have been expected.

The San José scale was destroyed in large numbers by the winter-killing of trees, and to some extent on those which survived the winter. This demonstrates that this insect is not entirely hardy during severe winters in this latitude. Unfortunately, enough succeeded in living to produce many young during the summer, so that this insect is now somewhat more abundant than it was a year ago. It is generally distributed over the State east of the western slopes of the Connecticut valley, but seems not to have penetrated the Berkshire hills to any great extent. Spraying with the lime-sulphur mixture for this pest has been made use of by many fruit growers and others, and has proved to be an excellent method for its control.

Plant lice and root maggots have been fairly abundant this year, due perhaps to their great increase during 1903 enabling them to have so many descendants that a larger number than usual succeeded in passing the winter.

The white fly (*Aleyrodes*) in greenhouses has apparently spread in all directions, complaints of the destruction it has caused having been received from all parts of the State.

The red spider (*Tetranychus*, spp.) has also been very abundant, both in greenhouses and outside, where a characteristic brownish tinge on the leaves of affected plants has often been very noticeable.

The usual amount of correspondence about the treatment for ants in houses and on lawns, about cut-worms, wire worms, the oyster-shell and scurfy scales and the various soft scales, indicates that these pests have been as abundant as ever, and that many people are still entirely ignorant of the appearance of their commonest insect foes.

The brown-tail moth has continued to spread over the State, and has been found in Lunenburg, Clinton and Whitman, by the State nursery inspectors. This indicates that the insect is spreading westward rapidly, and that it will be present in all parts of Massachusetts within a very few years. During the middle of July, while the moths were flying, it was noticeable that they were attracted to light, many being destroyed by flying into open arc lights on the streets, in some cases falling to the ground below the lights in such numbers as to form heaps of noticeable size.

It has usually been believed that the amount of feeding done by these insects in the fall was so slight that it could be ignored. This year, however, the caterpillars, after hatching and even after forming their tents, fed so much that where they were abundant all the foliage was skeletonized and turned brown. This was very noticeable in parts of Belmont, Arlington, Winchester and elsewhere. After the pear and apple, oaks seemed to be a favorite food for this insect, and the browning of the foliage in places was so great that newspapers called attention to "an extra brood" of this pest, and in some cases discovered that it was "a new and hitherto unknown insect" which was causing the injury.

The gypsy moth is now generally distributed over its original territory, and in one or two places has spread beyond it. In the districts where it is most abundant, the destruction it formerly caused when unchecked is again seen, and the result if no means of repression or control are taken can easily be imagined by any one who has visited these places. Local organizations in the infested districts are taking action to destroy this and the brown-tail moth, and are doing splendid work; but this should be supplemented by work on broader lines and with more power than local organizations possess, if lasting results are to be hoped for.

REPORT OF THE AGRICULTURISTS.

WM. P. BROOKS; ASSISTANTS, F. R. CHURCH, S. B. HASKELL.

The work of the agricultural department of the experiment station during the past year has in the main followed the general lines of investigation which have recently engaged attention. These for the most part are connected with questions affecting the selection and use of manures and fertilizers. To give results of value, such experiments require numerous repetitions, because of variation in product due to seasons and to conditions which we cannot fully control. In the averages of a series of years the influence of such variations is in a measure eliminated, and deductions based upon such averages will serve as a basis in farm practice.

The work of the past season has involved the care of over 220 plots in the open field, 150 closed plots and 278 pots in vegetation experiments.

Our grass garden, which includes 48 species and 7 varieties, most of them occupying 1 square rod of land, has been cared for as usual. One-half of the area in each species has been kept constantly lawn-mown, with a view to studying the probable effects of grazing; and a considerable number of species which had become mixed have been renewed, after paring and burning the old turf for the destruction of seeds and roots of weeds and other grasses.

Numerous experiments with alfalfa, both on our own grounds and on the grounds of selected farmers, are in progress. The results of this work are to be given in a bulletin. It suffices for the present to say that we have nowhere attained results so satisfactory that the extensive sowing of this crop can be advised; it must still be regarded as in the experimental stage.

A few cultures of nitrogen-assimilating bacteria, sent out by the Department of Agriculture for use with legumes, have been tried, and, so far as can be judged, with disappointing results. A bulletin descriptive of this work and the results obtained will be prepared in due time.

We have increased the scope of our work with the new and promising varieties of timothy received from Prof. A. D. Hopkins of the West Virginia Experiment Station, five years ago. Several of these are distinct improvements upon the ordinary commercial timothy, and these are being increased as rapidly as possible, for the production of seed which will later be furnished to selected farmers for trial.

Variety work with wheat, oats and barley has engaged considerable attention. Seeds of 31 varieties which for a series of years had given remarkable crops in the Dominion of Canada were kindly donated for the purpose by Dr. William Saunders, director, Experimental Farms of Canada. It was hoped that these northern-grown grains might prove valuable, but the results were disappointing. Practically all varieties were affected by rust, and the yields of most were small. The range of variation in the crops obtained was as follows: for wheat, at the rate of from 6 to 15 bushels per acre; for barley, at the rate of from 6 to 26 bushels per acre; for oats, at the rate of from 40 to 55 bushels per acre. Among the varieties of oats, the Improved Ligowa, Bavarian, Thousand $ and Wide Awake gave the best yields, — all in excess of 50 bushels. These varieties would seem to be worthy of further attention.

The work with poultry has been along the same lines as last year, the relations of food combinations to egg production being the subject under investigation.

The statement of results obtained, presented in detail in this report, does not cover all the experiments in progress.

The principal subjects of inquiry discussed, and the more important results, are as follows: —

I. — To determine the relative value of barnyard manure, nitrate of soda, sulfate of ammonia and dried blood as sources of nitrogen. The crop of this year was potatoes, and, on the basis of yield, the rank of the nitrogen-furnishing materials is as follows: barnyard manure, nitrate of soda, dried blood, sulfate of ammonia. The nitrate ranks relatively lower this year than in any previous year of the experiment except last. On the basis of increases in all the crops grown since the experiment began, as compared with the no-nitrogen plots, the materials rank as follows: nitrate of soda, 100; barnyard manure, 83.6; dried blood, 66.9; sulfate of ammonia, 56.9. In this experiment we are also testing the stubble value to succeeding crops of legumes on the no-nitrogen plots. The results of this year indicate the soy bean crop stubble to have been of little value.

II. — To determine the relative value of muriate, as compared with high-grade sulfate of potash, for field crops. The results of this year indicate the sulfate to be considerably superior to the muriate both for rhubarb and for cabbages.

III. — To determine the relative value of different potash salts for field crops. The salts under comparison are high-grade sulfate, low-grade sulfate, kainit, muriate, nitrate, carbonate and silicate. The crops of this year were cabbages, field corn and ensilage corn. The most striking results of the comparison are the relatively very low yield of the silicate of potash and the relatively high yields obtained on the nitrate and the carbonate.

IV. — To determine the relative value of phosphates used in quantities furnishing equal phosphoric acid to each plot. The crop of this year was corn. The most striking result was the very inferior yield produced on the plot where Florida soft phosphate is used. This result, in exact agreement with results with different crops in earlier years, indicates a very low degree of availability for this phosphate.

V. — *A.* Soil test with corn. The crop of this year, the sixteenth during which the experiment has continued, was excellent on all plots to which potash has been annually applied. Where muriate of potash alone has been continuously used, the yield was at the rate of about 47 bushels per acre. Where muriate of potash and dissolved boneblack have been continuously used, the yield was at the rate of 53 bushels per acre, which is the best crop produced on any combination of fertilizers, and actually exceeds the yield on the plot where manure has been annually applied at the rate of 5 cords per acre. The experiment strikingly shows the great importance of the liberal supply of potash in fertilizers for the corn crop. *B.* Soil test with grass and clover. The nitrate of soda, whether used alone or in combination, caused a large increase in the first crop. The use of potash without lime had little effect upon the crop. Where potash has been used continuously for fifteen years, with two heavy applications of lime (in 1899 and 1904), the effect on the proportion of clover and on total yield was very marked. The most profitable crop produced by any fertilizer combination was obtained upon the plot to which dissolved bone-black and muriate of potash have been continuously applied. On the limed portion of this plot the yield is at the rate of 6,100 pounds of hay. The annual cost of the fertilizers applied to this plot has been $7.50.

VI. — To determine the relative value in crop production of a fertilizer mixture rich in potash, as compared with one representing the average of the special corn fertilizers purchasable in our markets. The result of this year is substantially equal crops under the two systems of manuring, at a cost of rather over $5 per acre less for the combination of fertilizers richer in potash.

VII. — To determine the relative value in corn production of a moderate application of manure alone, as compared with a smaller application of manure used in combination with 160 pounds of high-grade sulfate of potash per acre. The result of this year was crops under the two systems equal in amount of stover, but an average at the rate of 5 bushels of grain per acre less on the combination of manure and potash than on the manure alone. The difference in crop is not sufficient to cover the excess in cost of the larger amount of manure alone, as compared with the lesser amount of manure and potash.

VIII. — To determine the economic result of using in rotation on grass lands, the first year, barnyard manure, 8,000 pounds per acre; the second year, wood ashes, 1 ton per acre; and the third year, bone meal, 600, and muriate of potash, 200, pounds per acre. The average yield of hay during the past season, all three systems of manuring being represented on a total area of about 9 acres, is at the rate of 8,050 pounds of hay per acre. The average for the twelve years during which the experiment has continued (1893 to 1904, inclusive) is 6,718 pounds.

IX. — To determine which is better economy, — to spread manure as hauled from the stable during the winter, or to place in a large heap to be spread in spring. This experiment was repeated in five pairs of plots. The winter application gave the better yield in three cases, the spring application in two; but the difference in the value of the crop where the spring application gave the larger yield was not sufficient to cover the difference in the cost of the two systems of handling the manure, which amounts to $4.80 per acre. The winter of 1903 and 1904 was exceptionally favorable to good results from application at that season, as conditions were such that there was no washing over the surface.

X. — To determine whether the application of nitrate of soda after the harvesting of the first crop will give a profitable increase in the rowen crop. The increases produced were considerable, but, possibly because of somewhat deficient rainfall, were not sufficient to make the application distinctly profitable.

XI. — The variety test of potatoes. Forty-nine varieties of potatoes were tested. The yield obtained from the different varieties ranged from 104 bushels of merchantable potatoes per acre for the Clinton to 319 bushels of merchantable potatoes per acre for Simmon's Model. Seven varieties gave a yield in excess of the rate of 260 bushels per acre, namely: Simmon's Model, Extra Early White Rose, Great Divide, Steuben, 1904, Mills' New Rose Beauty. These varieties are mentioned in the order of their productiveness.

XII. — Comparison of different foods and combinations of foods furnishing essential nutrients in different nutritive ratios for laying hens. The hens were supported, at a cost of about ⅙ of a cent per hen daily, on mixtures of food rich in corn, as compared with a cost of about ¼ of a cent per hen daily, on mixtures of food rich in wheat. The food cost per egg was lowest on the food mixtures containing a large proportion of corn. The combination of feeds including a considerable portion of rice and rice meal gave the most satisfactory egg yield of any combination tested, but the cost of rice is too great to make it an economical food for poultry.

I. — MANURES AND FERTILIZERS FURNISHING NITROGEN COMPARED. (FIELD A.)

The experiments in Field A have two principal objects in view: first, to compare the efficiency (as measured by crop production) of a few standard materials which may be used on the farm as sources of nitrogen; second, to determine to what extent the introduction of a legume will render the application of nitrogen to a succeeding crop of another family unnecessary. The field includes eleven plots of one-tenth acre each. A full description of the plan followed will be found in the twelfth annual report of the Hatch Experiment Station. The materials furnishing nitrogen under comparison are barnyard manure, nitrate of soda, sulfate of ammonia and dried blood. With few and unimportant exceptions, each plot has been manured in the same way since 1890. All the plots annually receive equal and liberal amounts of materials supplying phosphoric acid and potash. Three plots in the field have had no nitrogen applied to them since 1884; the materials under comparison on the other plots in the field are applied in such quantities as to furnish nitrogen at the rate of 45 pounds per acre to each. Barnyard manure is applied to one plot, nitrate of soda to two, sulfate of ammonia to three and dried blood to two plots. The potash applied to these plots is supplied in the form of muriate to six plots, namely, 1, 3, 6, 7, 8 and 9. It is supplied in the form of low-grade sulfate to four plots, namely, 2, 4, 5 and 10. The crops grown in this experiment previous to this year in the order of their succession have been: oats, rye, soy beans, oats, soy beans, oats, soy beans, oats, oats, clover, potatoes, soy beans, potatoes, soy beans.

The crop of this year was potatoes. The variety was the Green Mountain. The seed, which was of fine quality, was grown in northern Maine. The land was plowed on May

3; manure and fertilizers were applied on the 7th, and the potatoes, which had been soaked in formalin solution for prevention of scab, were planted on May 11. The crop was thoroughly cared for throughout the season, although there was some injury from bugs, apparently due to the fact that the Paris green used for the first spraying on June 27 was impure. The vines were sprayed three times with Bordeaux mixture and Paris green: respectively, July 3, 18 and 30. There was apparently little injury from blight. The leaves on the plot to which manure was applied retained their green color considerably longer than those on the other plots. On September 10 they were estimated to be still about one-half green, while the proportion still remaining green on other plots was in general estimated to be about one-tenth to one-eighth. By September 22 the tops were dead, and the potatoes were dug between that date and the 29th. The rates of yield on the several plots and the source of nitrogen on each are shown in the following table: —

Yield of Potatoes per Acre (Bushels).

Plots.	NITROGEN FERTILIZERS USED.	Merchantable.	Small.
0, . .	Barnyard manure, ...	236.67	41.67
1, . .	Nitrate of soda (muriate of potash), ...	190.83	36.00
2, . .	Nitrate of soda (sulfate of potash), ...	188.17	33.50
3, . .	Dried blood (muriate of potash), ...	141.83	36.00
4, . .	No nitrogen (sulfate of potash), ...	96.33	30.00
5, . .	Sulfate of ammonia (sulfate of potash), . . .	157.50	19.17
6, . .	Sulfate of ammonia (muriate of potash), . . .	102.50	13.83
7, . .	No nitrogen (muriate of potash), ...	104.83	11.50
8, . .	Sulfate of ammonia (muriate of potash), . . .	113.50	32.50
9, . .	No nitrogen (muriate of potash), ...	141.67	36.17
10, . .	Dried blood (sulfate of potash), ...	232.33	24.17

The yield on the different plots varies widely, that on the plot receiving manure being the best in the field, and standing relatively much higher as compared with the plots receiving their nitrogen in the form of a fertilizer than in any previous year. It is believed that this result must be in large measure a consequence of the fact that the application of barnyard manure tends to maintain the stock of humus in the soil, and so keeps it in a condition more favorable to productive capacity. Neither the soy bean nor the potato leaves a residue which contributes materially to the humus content of the soil, and no other crops have been grown during the past five years. Experiments in continuous potato culture without manures in the Cornell University Experiment Station have shown in a striking manner the dependence of this crop upon the presence of a suitable proportion of organic matter in the soil.[1] The common observation that potatoes thrive exceptionally well in virgin soils and upon sod land points in the same direction.

The superiority of the yield on Plot 10 also is striking. This, in the writer's opinion, is due to the fact that the potatoes on this plot were covered by hand, while those on the other plots were covered by the use of the plow. The potatoes on this plot came up much more quickly and more vigorously than those on the others, and showed decided superiority in growth from the start.

The average yields of this year on the several fertilizers are shown in the following table: —

FERTILIZERS USED.	Merchantable (Bushels).	Small (Bushels).
Average of the no-nitrogen plots (3), ...	114.11	25.89
Average of the nitrate of soda plots (2), ...	189.25	34.75
Average of the dried blood plots (2), ...	186.83	30.09
Average of the sulfate of ammonia plots (3), . . .	124.50	21.67

As the result of all experiments previous to this year, it is found that the materials furnishing nitrogen have produced crops in the following relative amounts: —

	Per Cent.
Nitrate of soda, ...	100.00
Barnyard manure, ...	94.00
Dried blood, ...	90.40
Sulfate of ammonia, ...	90.30
No nitrogen, ...	72.80

Similar averages for this year are as follows: —

	Per Cent.
Nitrate of soda, ...	100.00
Barnyard manure, ...	124.30
Dried blood, ...	96.80
Sulfate of ammonia, ...	65.30
No nitrogen, ...	62.50

As was the case last year, the nitrate of soda stands relatively lower than in experiments of previous years, although it still maintains its superiority as compared with the other fertilizers furnishing nitrogen. The barnyard manure produces a superior crop, not, it is believed, because of the superior availability of the nitrogen it contains, but, as has been suggested, because of the better physical condition of the soil produced by the humus it furnishes.

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[1] Bulletin No. 196, Cornell University Experiment Station, p. 52.

If we compare the different materials used as sources of nitrogen on the basis of increase in crop rather than on the basis of total product, they rank to date for the entire period of the experiment 1890 to 1904 as follows: —

Relative Increases in Yields (Average for the Fifteen Years).

	Per Cent.
Nitrate of soda,	100.00
Barnyard manure,	83.60
Dried blood,	66.90
Sulfate of ammonia,	59.90

These figures make the superiority of nitrate of soda as a source of fertilizer nitrogen very apparent. In view of the fact that at current prices it furnishes a pound of nitrogen at a lower cost than almost any other material, the advisability of depending chiefly upon the nitrate as a means of supplying the important element nitrogen becomes strikingly evident.

Effect of a Legume upon the Following Crop.

It is pointed out, in introducing what will be said under this topic, that the object in this experiment is not to test the effect of producing a legume which is plowed under, but simply the improvement, if any, derived from the roots and stubble the legume leaves behind when harvested. The results thus far indicate little improvement in the condition of the soil following the culture of the soy bean, with the exception of those obtained with the potato crop following soy beans in 1902. The introduction of the clover crop, on the other hand, was followed by marked improvement; and it would now appear possible that the good results with the potato crop in 1902 may have been in part at least a consequence of the unexhausted residue of the clover stubble and roots turned under in the spring of 1900. The following table, with the curve below it, makes the facts clear: —

Effect of Leguminous Crops upon the Following Crop (Pounds).

Plots (Each One-tenth Acre).	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.
	Oats.	Rye.	Soy Bean.	Oats.	Soy Bean.	Oats.	Soy Bean.	Oats.
Nitrogen plots, . .	343	484	1,965	598	620	494	1,740	445
No-nitrogen plots, .	290	421	1,443	540	452	370	1,148	197

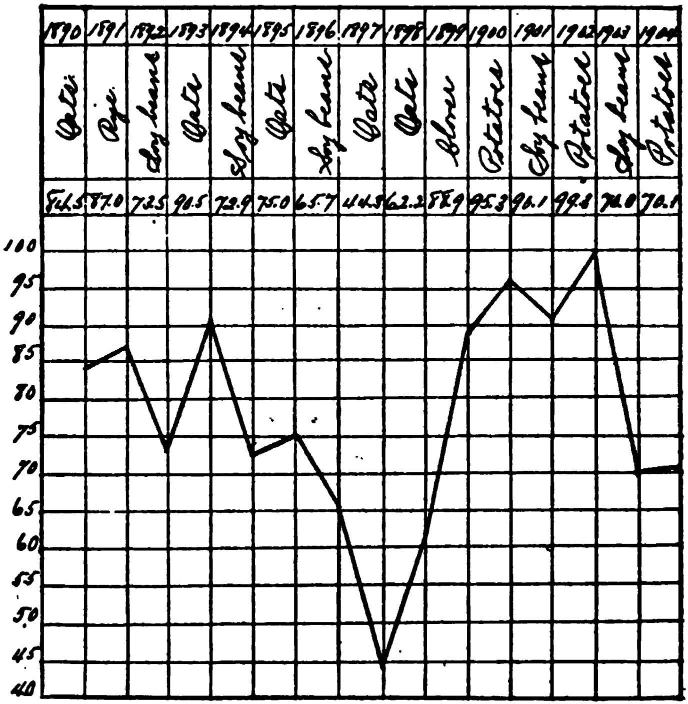
Effect of Leguminous Crops upon the Following Crop (Pounds) — Concluded.

Plots (Each One-tenth Acre).	1898.	1899.	1900.	1901.	1902.	1903.	1904.
	Oats.	Clover.	Potatoes.	Soy Bean.	Potatoes.	Soy Bean.	Potatoes.
Nitrogen plots, . .	254	413	1,316	442.21[1]	1,053.6	2,726	1,199
No-nitrogen plots, .	158	367	1,254	398.31[1]	1,046.0	1,907	840

[1] Dry beans and straw.

Curve showing Relation of Average No-nitrogen to Average Nitrogen Plots, the Latter being considered in Each Year 100.

[Per cent. average no-nitrogen to average nitrogen.]



It will be noticed that the crops following soy beans have as a rule showed little improvement which can be attributed to that crop. So long as the soy bean was the legume grown, the crops on the no-nitrogen plots continued in general to decline, as compared with the crops obtained upon the nitrogen plots. This is indicated by the fairly uniform and comparatively rapid fall in the line indicating the relative production. The introduction of clover causes a marked rise in the line indicating production, and this continues during the first three seasons following the plowing of the clover sod. The effect of the soy beans upon the crop of potatoes grown in 1902 appears to have been distinctly beneficial; but, as was stated in the fifteenth annual report, the fact that the potato crop in 1902 suffered from blight undoubtedly favored the plots where the growth was relatively feeble. In commenting upon the results obtained in 1902, I said: —

> It may be that the relative standing of the no-nitrogen plots is higher than it would have been had the crop of potatoes grown to normal maturity. It will be remembered that blight and rot prevailed to a considerable extent, and these would naturally injure the potatoes with the ranker growth more than those where the growth was less luxuriant. It does not seem, therefore, that we are justified in concluding that the after-effect of the soy beans is as useful as the relation between the figures appears to indicate.

In view, then, of the doubt as to whether the true relative capacity for product was shown in 1902, and the further fact that all other years show a general agreement in not indicating a decided benefit following the introduction of the soy bean as a crop, we seem to be justified in the conclusion that the residual fertility left behind by the soy bean is comparatively unimportant.

II. — THE RELATIVE VALUE OF MURIATE AND HIGH-GRADE SULFATE OF POTASH. (FIELD B.)

The object in view in this experiment is to test the relative value of muriate and high-grade sulfate of potash when used continuously upon the same soil. The experiment was begun in 1892. The potash salts were used for the period from 1892 to 1899 inclusive, at the rate of 400 pounds per acre; since 1900 the rate of application has been 250 pounds per acre. Fine-ground bone at the rate of 600 pounds per acre has been yearly applied to all plots. The number of plots in the field at present is ten, five receiving muriate of potash, and alternating with the same number of plots which yearly receive sulfate of potash. Various crops have been grown in rotation, including potatoes, field corn, sweet corn, grasses, oats and vetch, barley and vetch, winter rye, clovers of various kinds, sugar beets, soy beans, and cabbages. Most of these crops have been grown during several years. With few exceptions, good yields have been obtained. Among the crops grown, the potatoes, clovers, cabbages and soy beans have usually done best on sulfate of potash. The yield of corn, grasses, oats, barley, vetches and sugar beets has been about equally good on the two salts, while the quality of the potatoes and sugar beets when grown on sulfate of potash has been distinctly better than on muriate of potash. Three years ago, two of the plots in this field were set to small fruits, asparagus and rhubarb, — on each plot one row each of raspberries, blackberries, asparagus and rhubarb. Aside from the crops just named, those of the past year have been cabbages on two plots and three varieties of clover, namely, Mammoth Red, Medium Red and Alsike, each on two plots. The clover was sown in the spring, and the product of the plots was considerably mixed with weeds; for this reason, the weights were not taken. There was no readily distinguishable difference in the growth of either the Medium or the Mammoth clovers that could be attributed to the difference in potash manuring. The Alsike clover upon the plot manured with sulfate of potash has made a distinctly better start than that on the muriate. Neither the asparagus, raspberries nor blackberries have yet become sufficiently established to give a full crop, and the results will not be reported in detail. The yield of asparagus was substantially equal on the two potash salts. The yield of raspberries on the muriate of potash was considerably greater than on the sulfate. Observation of the growth of the berry bushes and asparagus since they were set indicates that the rate of manuring which has been the practice on this field does not maintain the soil in sufficiently high fertility to produce satisfactory growth on either of the combinations of fertilizers employed. During the past season, therefore, we have used nitrate of soda at the rate of 200 pounds per acre, in connection with the customary amounts of bone meal and potash, on the plots occupied by these crops.

1. *Rhubarb* (*Sulfate v. Muriate of Potash*).

The rhubarb grown in this experiment is of the Monarch variety. The growth has been vigorous and healthy. The product of this year is shown in the following table: —

Muriate v. High-grade Sulfate of Potash (*Rhubarb*). — *Yields per Acre* (*Pounds*).

FERTILIZERS USED.	Stalks.	Leaves.
Muriate of potash, ...	8,421	11,957
Sulfate of potash, ...	8,559	14,286

The yield of stalks on the two plots is substantially equal, but the weight of the leaves accompanying the stalks produced on the sulfate of potash is materially greater than on the other potash salt. Whether this fact has any special significance is not at present known; but it is at least suggestive that on Field C, where, under conditions otherwise differing quite widely from those in Field B, the muriate is compared with the sulfate, a similar difference in weight of leaves as compared with stalks is found. It is, of course, evident that the results of this year do not throw any important light upon the question as to whether there is any important practical difference in the two potash salts for this crop.

2. *Cabbages* (*Sulfate v. Muriate of Potash*).

The variety of cabbages grown this year was Fottler's Brunswick Drumhead. The seed was planted in hills two feet apart and in rows three and one-half feet apart, on June 30. The plants were thinned first to two in a hill, and later, on August 16, to one. The summer and the autumn, especially the latter, averaged much below the normal temperature, and the cabbages were by no means matured on the approach of weather which compelled their harvesting. With a normal season there is no doubt that nearly all the plants would have produced merchantable heads. Under existing conditions a very large proportion of the heads were regarded as too soft to be included in that class. The yields per acre are shown in the following table: —

Muriate v. High-grade Sulfate of Potash (Cabbages). — Yields per Acre (Pounds).

FERTILIZERS USED.	Hard Heads.	Soft Heads.
Muriate of potash, ...	872	22,791
Sulfate of potash, ...	2,071	24,312

It will be seen that the product on the sulfate of potash is considerably superior to that on the muriate. The yield of hard heads is nearly two and one-half times as great, while the yield of soft heads also somewhat exceeds that on the muriate. As this result is in general agreement with that usually obtained heretofore with the cabbage crop, it tends to still further confirm the conclusion that it is best that the potash used for this crop be in the form of sulfate rather than muriate.

III. — COMPARISON OF DIFFERENT POTASH SALTS FOR FIELD CROPS. (FIELD G.)

Field G contains 40 plots, of about one-fortieth of an acre each. The experiments in progress have for their object the determination of the relative value for field crops of all the prominent potash salts when each is used continuously upon the same land throughout a long series of years. This experiment was begun in 1898. The plots are arranged in five series of eight each. In each series one plot has received no potash since the experiment began. The potash salts under trial are as follows: kainit, high-grade sulfate of potash, low-grade sulfate of potash, muriate of potash, nitrate of potash, carbonate of potash and silicate of potash. Each is always applied in such quantity as to furnish actual potash at the rate of 165 pounds per acre. All the plots in the field are yearly fertilized with materials supplying to each equal amounts of nitrogen and phosphoric acid. For nitrogen, nitrate of soda is applied at the rate of 250 pounds per acre, except on the plots where nitrate of potash is the source of the potash applied; here a suitable reduction in the quantity of nitrate of soda is made, on account of the nitrate nitrogen furnished by the potash salt. The principal source of phosphoric acid on these plots is acid phosphate, applied at the rate of 360 pounds per acre to all. Tankage at the rate of 270 pounds per acre is applied to all plots as a source of less immediately available nitrogen and phosphoric acid. The crops grown in this experiment in the order of succession are as follows: 1898, Medium Green soy beans; 1899, Beauty of Hebron potatoes; 1900, Fottler's Brunswick cabbage, Medium Green soy beans, Black cow pea, Wonderful cow pea; 1901, Turkish Red wheat, Medium Red clover; Rural Thoroughbred, Leaming Field, Boston Market and Eureka corn; 1902, Medium Red clover; 1903, Medium Red clover.

During the past season the crops grown in the field were as follows: cabbages on sixteen plots, two series of eight each; Sibley's Pride of the North corn on sixteen plots, two series; and Leaming Field corn for ensilage on eight plots. The season was unfavorable to full maturity for the cabbage crop, for reasons which have been alluded to in discussing results on fields B and C. For the same reasons, and also because of the excessive rains at the season of planting, the season was highly unfavorable to the corn crop. Defective germination, owing to the excessive rains, produced an uneven stand of plants in the areas devoted to corn. For the reasons indicated, it does not seem worth while to publish the results in full detail, and averages only will be given. These for the cabbages are as follows: —

Cabbages. — Average Rates of Yield per Acre (Pounds).

POTASH SALT.	Hard Heads.	Soft Heads.
No potash (plots 1, 9),	10,850	22,850
Kainit (plots 2, 10),	11,100	26,150
High-grade sulfate (plots 3, 11),	10,600	25,500
Low-grade sulfate (plots 4, 12),	12,100	27,400
Muriate of potash (plots 5, 13),	11,900	26,600
Nitrate of potash (plots 6, 14),	14,800	23,100
Carbonate of potash (plots 7, 15),	16,500	23,400
Silicate of potash (plots 8, 16),	10,650	25,050

The most striking points brought out by these figures are: first, the high-grade sulfate of potash fails to show the superiority in yield to muriate which has generally been shown; second, the nitrate and carbonate of potash have given yields very materially exceeding those obtained on any of the other potash salts; third, the yield on the silicate of potash is one of the poorest in the field.

Field Corn.—Average Yields per Acre.

POTASH SALT.	Sound Corn (Bushels).	Soft Corn (Bushels).	Stover (Pounds).
No potash (plots 17, 25),	15.00	17.78	3,740
Kainit (plots 18, 26),	20.25	14.00	4,300
High-grade sulfate (plots 19, 27),	19.50	13.45	4,340
Low-grade sulfate (plots 20, 28),	17.75	14.34	4,200
Muriate of potash (plots 21, 29),	20.50	14.44	4,660
Nitrate of potash (plots 22, 30),	17.00	13.45	4,020
Carbonate of potash (plots 23, 31),	17.00	15.78	4,420
Silicate of potash (plots 24, 32),	13.75	18.56	4,160

The most striking point brought out by these averages is the poor results where the silicate is the potash salt employed. Aside from this, the results with corn seem to be in general accord with those which have been usually obtained, which indicate that the different potash salts appear to have substantially similar effects upon this crop.

Ensilage Corn.—Average Yield per Acre (Pounds).

POTASH SALT.	Green Fodder.	POTASH SALT.	Green Fodder.
No potash (plot 33),	28,800	Muriate (plot 37),	36,800
Kainit (plot 34),	33,800	Nitrate (plot 38),	32,800
High-grade sulfate (plot 35),	34,600	Carbonate (plot 39),	30,000
Low-grade sulfate (plot 36),	36,600	Silicate (plot 40),	23,400

In the case of the ensilage, as well as field corn, the silicate of potash gives a yield much inferior to that produced by the other potash salts. That the silicate, whether with cabbages, field or ensilage corn in each of the five series of plots where it is employed, gives yields inferior to those obtained with the other potash salts, and that the yield does not in some cases equal even the yield obtained from the no-potash plot, is a fact which it seems desirable to point out. Up to the present year the yields on silicate of potash with the different crops grown have not been markedly inferior to those obtained on other potash salts. It is impossible, in the light of our present knowledge of the conditions, to offer an explanation of the facts, although it is, of course, evident that the soil, which was originally in fair condition as regards its stock of available potash, has previous to this year been in condition to furnish a larger share of the potash needed by the crop than at present. With increasing exhaustion of natural stores of potash, the differences due to the several fertilizers used may naturally be expected to increase.

IV. — COMPARISON OF PHOSPHATES ON THE BASIS OF EQUAL APPLICATION OF PHOSPHORIC ACID.

The present is the eighth season of this experiment, which has for its object the determination as measured by crop production, of the relative availability of different materials which may be used as sources of phosphoric acid when used in such quantities as to furnish equal amounts of actual phosphoric acid to each plot, and in connection with materials which supply the other elements of plant food, especially the nitrogen and the potash, in abundance and in the same forms and in equal amounts on each of the plots. The field in which these experiments are carried on is divided into thirteen plots, of about one-eighth of an acre each. Three plots in the field, one at each end and one in the middle, have received no phosphoric acid since the experiment began. The phosphates which are employed on the other plots are as follows: apatite, South Carolina rock phosphate (fine ground), Florida soft phosphate, basic slag meal, Tennessee rock phosphate (fine ground), dissolved bone-black, raw bone meal, dissolved bone meal, steamed bone meal and acid phosphate. These phosphates are used in such quantities as to furnish actual phosphoric acid, at the rate of 96 pounds per acre. The nitrogen and potash fertilizers used supply nitrogen at the rate of 52 pounds and potash at the rate of 152 pounds per acre. With some of the crops grown (onions and cabbages) a supplementary application of quick-acting nitrogen fertilizers has been made to all plots alike. The crops which have been grown in the field during the progress of the experiment are as follows: corn, cabbages, corn, in 1900 two crops, — oats and Hungarian grass (both for hay), onions, onions, and cabbages. With the exception of the onions and cabbages, all the crops previously grown in the field have given good yields, even on the three no-phosphate plots. The soil of the different parts of the field was not even in fertility at the start. Plot 1 was somewhat more productive than any of the others, and in general the plots tended to decline in productiveness from 1 toward 13. The crop the past season was corn. The soil of the field inclines to be heavy, and the corn crop during the prevailing cool weather of the past season suffered from poor soil conditions and low temperature, especially on plots 8, 11, 12 and 13. Observation of the growth of the crop of the preceding year (cabbages), and study of the soil conditions throughout the preceding season, had led to the conclusion that the physical and chemical conditions of the soil in the field would be improved by a heavy application of lime. The field was plowed in the fall of 1903. Freshly slacked lime to the amount of 4,675 pounds (about 2,000 pounds per acre) was applied on May 10 and plowed in on May 15. The variety of corn grown was the Leaming Field. The seed was obtained of E. E. Chester & Son, Champaign, Ill., and was of excellent quality. The rainfall was so excessive, however, that there were a few blanks in some of the plots. The crop was cut on September 19 and immediately weighed and put into the silo. The rates of the yields on the several plots are shown in the following table: —

Plots.	FERTILIZERS USED.	Green Corn (Pounds per Acre).
1,	No phosphate,	41,000
2,	Apatite,	40,720
3,	South Carolina rock phosphate,	40,496
4,	Florida soft phosphate,	28,240
5,	Phosphatic slag,	36,440
6,	Tennessee phosphate,	32,120
7,	No phosphate,	32,344
8,	Dissolved bone-black,	30,080
9,	Raw bone,	45,800
10,	Dissolved bone meal,	41,840
11,	Steamed bone meal,	26,400
12,	Acid phosphate,	29,040
13,	No phosphate,	20,240

The point of principal significance in connection with the results appears to be the marked inferiority of the yield on the Florida soft phosphate. There was no difference in the physical conditions on this plot, as compared with those on either side, that can explain the wide difference in the amount of the product. The results of this year, then, additionally confirm the conclusions of previous years, — that this phosphate seems likely to give results which are distinctly disappointing, as compared with the claims of those interested in its production and sale. The low product on plots 8, 11 and 12 was undoubtedly in considerable measure due to the unfavorable conditions which have been referred to.

V. — SOIL TESTS.

In introducing what I have to say concerning soil tests, I cannot do better than to employ the language used in my last annual report, p. 244 : —

> Two soil tests, both upon our own grounds and both in continuation of previous work upon the same fields, have been carried out during the past season. Fertilizers have been applied in accordance with the co-operative plan for soil tests, with one or two small exceptions. Lime and plaster have been applied to the plots calling for these fertilizers in double the usual soil test amounts. Each plot annually receives an application of the same kind or kinds of fertilizers. Such experiments are not adapted to securing the production of heavy crops. By study of the results, the effects of the different leading elements of plant food on the several crops can be determined with much accuracy.
>
> Every fertilizer used, whether applied by itself or in connection with one or both of the other fertilizer materials, is always applied in the same quantities. Both fertilizers and manure (where the latter is introduced for purposes of comparison) are always applied broadcast after plowing, and harrowed in. The kinds and the amounts per acre are as follows: —

Nitrate of soda, 160 pounds, furnishing nitrogen.
Dissolved bone-black, 320 pounds, furnishing phosphoric acid.
Muriate of potash, 160 pounds, furnishing potash.
Land plaster, 400 pounds.
Lime, 800 pounds.
Manure, 5 cords.

A. — Soil Test with Corn (South Acre).

This acre has been used in soil tests for sixteen years, beginning in 1889. The crops for successive years have been as follows : corn, corn, oats, grass and clover, grass and clover, corn (followed by mustard as a catch crop), rye, soy beans, white mustard, corn, corn, grass and clover, grass and clover, corn, corn, and corn. Since 1889 this field has, therefore, borne eight corn crops, and during this time it has been four years in grass. The present is the third successive corn crop, these three crops following grass, which occupied the field in 1901. Last season was one of the most unfavorable for corn within the memory of our oldest men. The crop was exceedingly small, even on the land which had annually received an application of manure at the rate of 5 cords per acre. With only one exception, previous to last year, the corn crop wherever potash has been applied to the soil in this field has always been good. In 1898 the crop even where potash and other fertilizers had been used was small. This suggested the probable necessity of an addition of lime. The application of lime at the rate of 1 ton to the acre restored the productiveness of all the plots to which muriate of potash had been continuously applied. The small crop of last year, in connection with observations on the condition of the soil, led to the conclusion that lime might once more prove useful; the entire field, therefore, was given a dressing of freshly slacked lime, at the rate of 1 ton per acre. The marked increase in the crop of this year wherever potash was used indicates the correctness of the opinion that lime was needed. The plot where potash was used alone last year gave a yield at the rate of about 15.5 bushels of corn per acre ; this year the product is almost three times that amount. Last year the plot to which nitrate of soda and muriate of potash are annually applied gave a yield at the rate of 16.5 bushels per acre ; this year the yield is 47.8 bushels. The plot receiving dissolved bone-black and muriate of potash, which last year gave a crop of a little less than 19 bushels, this year gave a crop of rather over 53 bushels. These facts make it strikingly evident that, in connection with fairly liberal amounts of muriate of potash, it is essential to use lime freely on many of our soils, if their productiveness is to be maintained. This field contains four plots, to which neither manure nor fertilizer of any kind has been applied during the sixteen years that the experiment has continued. These plots have now become very highly exhausted, producing crops which are practically valueless so far as the production of grain is concerned, although the nominal yield is at the rate of about 3.5 to 8 bushels per acre. The following table shows the fertilizers used on the several plots, the rate of yield, and the gain or loss per acre compared with the nothing plots: —

Corn. — South Acre Soil Test, 1904.

Plots.	FERTILIZERS USED.	YIELD PER ACRE.		GAIN OR LOSS PER ACRE, COMPARED WITH NOTHING PLOTS.	
		Corn (Bushels, 90 Pounds).	Stover (Pounds).	Corn (Bushels, 90 Pounds).	Stover (Pounds).
1, .	Nitrate of soda, ...	7.11	1,200	2.78	330
2, .	Dissolved bone-black, . .	3.89	960	—.44	90
3, .	Nothing, ...	4.33	870	-	-
4, .	Muriate of potash, . . .	46.89	3,760	42.86	2,933
5, .	Lime, ...	2.67	820	—1.07	—37
6, .	Nothing, ...	3.44	740	-	-
7, .	Manure, ...	50.00	4,000	46.56	3,260
8, .	Nitrate of soda and dissolved bone-black.	15.11	1,500	6.33	320
9, .	Nothing, ...	8.78	1,180	-	-
10, .	Nitrate of soda and muriate of potash.	47.67	3,560	39.71	2,440
11, .	Dissolved bone-black and muriate of potash.	53.11	3,940	45.96	2,880
12, .	Nothing, ...	6.33	1,000	-	-
13, .	Plaster, ...	7.44	1,100	1.11	100
14, .	Nitrate of soda, dissolved bone-black and muriate of potash.	47.78	3,700	41.45	2,600

It will at once be noticed that the potash is the element which determines the crop, almost to the exclusion of all others. Where potash has been used alone during sixteen years, the yield is almost as great as it is with potash and any of the other combinations. Nitrate of soda alone does very little good. Dissolved bone-black alone gives a crop less than the average of the nothing plots. The combination of nitrate of soda and dissolved bone-black gives a very inferior crop, but wherever potash is used the crop is good. Particular attention is called, further, to the fact that the continuous use of lime alone is not beneficial; on the contrary, the yield on the plot where lime has been continuously used is the poorest in the field. Plaster used alone and continuously gives a slightly better crop, but not much in excess of the nothing plots. It may perhaps be urged that the soil of this field must be of very exceptional character; that, otherwise, the so long-continued use of one fertilizer element could not produce the results obtained. To a certain extent this criticism may be justified, and I do not call particular attention to the marked effect of the potash for the purpose of urging upon our farmers exclusive dependence upon this fertilizer, but to make more emphatic the point that our farmers in general should insist that fertilizers designed for use for the corn crop should be richer in potash than is usually the case. The results obtained in previous years on this field indicate not so much that this soil is deficient in potash, — for some crops, such as grass, for example, do well on the plots to which no potash has been applied since the beginning of the experiment, — as that the corn crop depends in a marked degree upon a liberal supply of readily available potash.

B. — Soil Test with Mixed Grass and Clover (North Acre).

The acre used in the north soil test has been kept in this experiment fifteen years, beginning in 1890. The fertilizers have been used in the same combinations and in general in the same amounts on the several plots as in the south soil test, except that during the years when onions have been grown the fertilizers have been used in double the usual quantities. Each fertilizer or combination of fertilizers has been used continuously upon the same plot. In this experiment the plots were divided transversely in 1899, and lime was applied at the rate of 1 ton to the acre to one-half of each plot. The lime was applied after plowing, and harrowed in. During the past season the same halves of all the plots have once more been limed, and at practically the same rate as before; but this year, as the land was in grass, the lime was applied as a top-dressing on the grass in spring. The date of application was May 13. The crops grown in this field, in the order of succession, beginning in 1890, have been: potatoes, corn, soy beans, oats, grass and clover, grass and clover, cabbages and ruta-baga turnips, potatoes, onions for four years (1898 to 1901 inclusive), potatoes, grass and clover, and grass and clover. The field was sown to grass and clover after the harvesting of potatoes in the autumn of 1902 (September 15). The rate of seeding per acre was: timothy, 18 pounds; red-top, 8 pounds; red clover, 5 pounds; and alsike clover, 4 pounds. The clover winter-killed, and accordingly additional clover seed (15 pounds) was sown on April 4, 1903.

On account of the deficiency in rainfall from the middle of April to about the 10th of June, 1903, the yields last year on all plots were very small. The yields during the past season have been much larger. They are shown in the following table: —

Grass and Clover. — North Acre Soil Test, 1904.

Plots.	Fertilizers used.	Yield per Acre, Hay.		Gain or Loss per Acre, compared with Nothing Plots.	
		Unlimed (Pounds).	Limed (Pounds).	Unlimed (Pounds).	Limed (Pounds).
1,	Nothing,	1,060	800	-	-
2,	Nitrate of soda,	1,960	1,600	1,067	880
3,	Dissolved bone-black,	1,000	680	273	40
4,	Nothing,	560	560	-	-
5,	Muriate of potash,	600	1,920	40	1,265
6,	Nitrate of soda and dissolved bone-black.	2,120	2,320	1,560	1,570
7,	Nitrate of soda and muriate of potash.	1,920	1,860	1,360	1,015
8,	Nothing,	560	940	-	-
9,	Dissolved bone-black and muriate of potash.	860	3,600	280	2,575
10,	Nitrate of soda, dissolved bone-black and muriate of potash.	2,200	4,400	1,600	3,290
11,	Plaster,	560	600	—60	—595
12,	Nothing,	640	1,280	-	-

Grass and Clover. — *North Acre Soil Test, 1904* — Concluded.

Plots.	FERTILIZERS USED.	YIELD PER ACRE, ROWEN.		GAIN OR LOSS PER ACRE, COMPARED WITH NOTHING PLOTS.	
		Unlimed (Pounds).	Limed (Pounds).	Unlimed (Pounds).	Limed (Pounds).
1, .	Nothing, ...	140	80	-	-
2, .	Nitrate of soda, ...	60	90	—80	7
3, .	Dissolved bone-black, . .	60	120	30	7
4, .	Nothing, ...	30	130	-	-
5, .	Muriate of potash, . . .	70	780	37	557
6, .	Nitrate of soda and dissolved bone-black.	210	810	175	495
7, .	Nitrate of soda and muriate of potash.	50	520	12	112
8, .	Nothing, ...	40	500	-	-
9, .	Dissolved bone-black and muriate of potash.	80	2,560	47	2,125
10, .	Nitrate of soda, dissolved bone-black and muriate of potash.	620	2,840	595	2,470
11, .	Plaster, ...	20	80	2	—225
12, .	Nothing, ...	10	240	-	-

The results of this year resemble those of last year in one particular, namely, the marked increase in the first crop which follows the application of nitrate of soda; but in one important particular the results this year differ from those of 1903 in a marked degree, namely, in the very large increase on the limed portion of those plots to which muriate of potash has been annually applied. In commenting upon the results of last year, I said: —

> Much evidence is afforded by a study of the relative proportions of the different species on the different plots and on the limed and unlimed portions of the several plots, that the soil in some parts of this field is once more becoming acid.

The principal ground on which this statement was based was the comparative absence of clover, even on the limed portion of such plots as had been supplied annually with potash. This relative absence of clover last year was doubtless in part due to the unfavorable climatic conditions; but the widely different results of this year indicate that the lime applied this season proved distinctly and largely beneficial.

It is desired to call particular attention to the yield both of hay and of rowen on the limed portion of Plot 9. This plot, it should be understood, has not received an application of anything furnishing nitrogen during the fifteen years that the experiment has continued; and yet on the limed portion of this plot we this year have a yield of hay at the rate of 3,600 pounds and a yield of rowen at the rate of 2,560 pounds per acre, — a total of rather over 3 tons, at a fertilizer cost at the rate of $6.50 per acre. Allowing for an application of lime at the rate of a ton once in eight years, the annual cost of the materials applied to this plot amounts to about $7.50 per acre. The yields obtained at this very low cost indicate in a most striking manner the possibilities in the production of clover hay on soils naturally suited to clovers, without the use of the expensive nitrogen manures or fertilizers.

It is of especial interest to compare the yields of Plot 10 with those on Plot 9. Plot 10 has annually received nitrate of soda, in addition to the same amounts of dissolved bone-black and muriate of potash as are used on Plot 9. The result is a fair hay crop, even on the part of the plot where lime has not been used. Here, however, as on Plot 9, the yield is greatly increased by the application of lime, and we have a total in the two crops of the year at the rate of 7,240 pounds per acre. This exceeds the yield of the two crops on Plot 9 at the rate of a little more than a thousand pounds per acre. This increase is produced as the result of an application at the rate of 160 pounds of nitrate of soda. Such an application would cost about $4, and the increase is therefore produced at a moderate profit.

As in previous years, the relative proportion of the different species (red-top, timothy and clovers) on the several plots has been carefully studied. The most important points noted are as follows: first, the use of nitrate of soda increases the proportion of red-top; second, potash increases the proportion of clover in a marked degree, and this influence is enormously increased on the limed portion of the plots.

It will be seen, by reference to the table showing how the fertilizers are applied, that Plot 6, which receives an application of nitrate of soda and dissolved bone-black annually, lies between two plots (5 and 7) each of which annually receives an application of potash. During the past season, and to some slight extent in previous seasons, it has been noticed that the growth of the crops on the edges of Plot 6, although it is separated from 5 and 7 by strips 3½ feet in width which have not received any fertilizer since the experiment began, shows plainly the influence of the potash applied to the neighboring plots, which has apparently diffused through the intervening 3½ feet strips, and is now beginning to affect the growth of the crops on Plot 6. During the past season there has been a little fringe of clover on each edge of Plot 6; this, however, has not been sufficient in amount to materially affect the yield on this plot, which, as will be seen, showed but little increase in the amount of rowen, which best measures the proportion of clover. The figures, however, for this plot are undoubtedly to some small degree misleading. The nitrate and the dissolved bone-black alone would produce little or no clover; they have, however, produced a fairly large crop of hay, about equally good on the unlimed and limed portions of the plot. This result is doubtless to be ascribed mainly to the effect of nitrate of soda in stimulating the growth of the grasses.

The relatively small increase on the limed portion of Plot 7, where nitrate of soda and muriate of potash are used together, appears to be due to the fact referred to in my last annual report, — that, where these two fertilizers are used together, soil effects very unfavorable to the growth of clover follow. It is believed that, to correct this unfavorable influence of these chemicals, lime must be used in very large amounts.

VI. — SPECIAL CORN FERTILIZER *v.* FERTILIZER RICHER IN POTASH.

It may be remembered that on this acre we are endeavoring to throw light upon the question as to the proper composition of fertilizers used alone for the corn crop. This experiment began in 1891. The crop from 1891 to 1896 inclusive was corn; in 1897 and 1898 the crop was mixed grass and clover; in 1899 and 1900 it was corn; in 1901 and 1902, grass and clover; in 1903 and 1904, corn. A statement of the results to date will be found in preceding annual reports. The object in view is to test the question as to whether the special corn fertilizers offered in our markets are of such composition as is best suited for the production of corn in rotation with mixed grass and clover. The field used in the experiment contains one acre, and is divided into four equal plots. Plots 1 and 3 have yearly received an application of mixed fertilizers, furnishing the same amount of nitrogen, phosphoric acid and potash as would be furnished by 1,800 pounds of fertilizer of the composition of the average of the special corn fertilizers analyzed at this station. This average has changed but little during recent years, and in 1899, since which date we have made no change in the kinds and amounts of fertilizers used, was as follows: —

	Per Cent.
Nitrogen,	2.37
Phosphoric acid,	10.00
Potash,	4.30

The various fertilizers offered in 1899 differed widely in composition. The extent of the variation is shown in the following table: —

	Per Cent.
Nitrogen,	1.5– 3.7
Phosphoric acid,	9.0–13.0
Potash,	1.5– 9.5

The fertilizers used on plots 2 and 4 are substantially the same in kind and amount as recommended in Bulletin No. 58 for corn on soils poor in organic matter. The essential difference in composition between the fertilizer mixtures under comparison is that that used on plots 2 and 4 is richer in potash and much poorer in phosphoric acid than the mixture representing the average market corn fertilizers. The fertilizers applied to the several plots are shown below: —

FERTILIZERS USED.	Plots 1 and 3 (Pounds Each).	Plots 2 and 4 (Pounds Each).
Nitrate of soda,	30.0	50.0
Dried blood,	30.0	-
Dry ground fish,	37.5	50.0
Acid phosphate,	273.0	50.0
Muriate of potash,	37.5	62.5

The crop of the past two seasons has been corn, the crop of 1903 being the first to follow mixed grass and clover, which occupied the land in 1901 and 1902. The season of 1904, while too low in average temperature for the best growth of corn, was distinctly more favorable to the crop than 1903. The following tables show the yields on the several plots and the averages for the two systems of manuring: —

Yields of Corn, 1904.

PLOTS.	Good (Bushels).	Soft (Bushels).	Stover (Pounds).
Plot 1 (lesser potash), ...	59.25	7.78	10,640
Plot 2 (richer in potash), ...	57.50	9.33	9,208
Plot 3 (lesser potash), ...	57.75	7.79	8,280
Plot 4 (richer in potash), ...	55.25	13.56	9,660

Average Yields per Acre.

PLOTS.	Good (Bushels).	Soft (Bushels).	Stover (Pounds).
Plots 1 and 3 (lesser potash), ...	58.50	7.78	9,460
Plots 2 and 4 (richer in potash), ...	56.37	11.45	9,434

It will be seen that the yields under the two systems of fertilization were substantially equal, although the grain on plots 1 and 3 was better ripened than on the other plots. During the early part of the season the growth of the corn on plots 1 and 3 was materially better than on plots 2 and 4; the plants showed a better color and were of larger size. This difference showed itself very early in the season. On July 6, it was judged that the plants on plots 1 and 3 averaged one and one-half times the height of the plants on the other plots, and the difference in the growth on that date was judged to be considerably less than at an earlier period. As the season advanced, the corn on plots 2 and 4 steadily gained in condition and size, as compared with that on plots 1 and 3; and by the end of the season, as the harvest showed, the initial superiority on plots 1 and 3 had entirely disappeared. At present we are not in a position to state to what cause the superior growth on plots 1 and 3 early in the season was due; but it appears probable that the cause was the stimulative effect of the excess of phosphoric acid, which, as has been repeatedly shown, when used in liberal amounts exercises a marked effect in hastening maturity.

At present prices for fertilizer materials, the fertilizers used on plots 1 and 3 cost, laid down in Amherst, at the rate of $19.25 per acre; those used on plots 2 and 4 cost at the rate of $14.20 per acre. The fertilizer combination richer in potash, therefore, costs a little more than $5 per acre less than the combination representing average corn fertilizers. It is significant that at this lower cost we have a corn crop equal to that produced at the higher figure. Last year, when the corn crop on all plots was very poor, the yield on plots 1 and 3 was distinctly better than on plots 2 and 4; but, with that exception, the average results to date show corn crops substantially equal on the two fertilizer combinations, while whenever the land is put into mixed grass and clover, the fertilizer combination richer in potash gives crops materially larger and of better quality than the combination richer in phosphoric acid. The advantage to date, therefore, is most decidedly in favor of the fertilizer combination containing the more potash; and fertilizer manufacturers are urged to increase the proportion of this element in corn fertilizers, and farmers on their part should insist on such increase.

VII. — Manure Alone *v.* Manure and Potash.

These experiments, which have for their object to show the relative value as indicated by crop production of an average application of manure used alone, as compared with a smaller application of manure used in connection with a potash salt, were begun in 1890. The field used is level, and the soil of comparatively even quality. It is divided into four quarter-acre plots. The crop grown during the years 1890 to 1896, 1899 and 1900, 1903 and during the past season, has been corn. In 1897 and 1898, and again in 1901 and 1902, the crop was mixed grass and clover. Where manure is used alone, it is applied at the rate of 6 cords per acre. Where manure is used with potash, the rates of application are: manure, 4 cords; high-grade sulfate of potash, 160 pounds per acre. Manure alone is applied to plots 1 and 3; the lesser quantity of manure and high-grade sulfate of potash to plots 2 and 4. Estimating the manure alone as costing $5 per cord, applied to the land, the money difference in the cost of materials applied is at the rate of $5.30 per acre, the manure and potash costing that amount less than the larger quantity of manure alone. The tables show the rates of yield on the several plots, and the averages, under the two systems of manuring.

Yield of Corn, 1904.

PLOTS.	Corn (Bushels).	Stover (Pounds).
Plot 1 (manure alone),	68.25	5,840
Plot 2 (manure and potash),	66.25	5,280
Plot 3 (manure alone),	66.50	4,280
Plot 4 (manure and potash),	58.25	4,840

Average Yields per Acre.

PLOTS.	Corn (Bushels).	Stover (Pounds).
Plots 1 and 3 (manure alone),	67.37	5,060
Plots 2 and 4 (manure and potash),	62.25	5,060

The averages made show an equal amount of stover produced under the two systems of manuring, and slightly more than 5 bushels of corn per acre less on the combination of manure and potash than on the larger quantity of manure alone. This difference in yield is not sufficient to pay the added cost of the larger quantity of manure applied to plots 1 and 3; but, since manure is an article of home production on most farms where corn is grown, not much importance would be attached to this point by the average farmer. The corn crops produced under the two systems of manuring previous to this year have been substantially equal. The inferiority in yield this year is of consequence only on Plot 4; and it is suspected that accidental variation in conditions determined the smaller product on this plot, rather than the difference in the system of manuring. We know that the plants in the field, on account of imperfect germination due to the unfavorable weather which preceded and followed planting, were not as thick as is desirable. The fact, however, that the yield of stover on Plot 4 is greater than that on Plot 3, renders it exceedingly doubtful whether the cause of the relatively small yield of corn on Plot 4 was the greater proportion of unoccupied space.

VIII. — EXPERIMENT IN MANURING GRASS LAND.

The report which is to be made concerning results in this experiment is best introduced by quoting from my sixteenth annual report: —

> In this experiment, which has continued since 1893, the purpose is to test a system of using manures in rotation for the production of grass. The area used in the experiment is about nine acres. It is divided into three approximately equal plots. The plan is to apply to each plot one year barnyard manure, the next year wood ashes, and the third year fine ground bone and muriate of potash. As we have three plots, the system of manuring has been so arranged that every year we have a plot illustrating the results of each of the applications under trial. The rates at which the several manures are employed are as follows: barnyard manure, 8 tons; wood ashes, 1 ton; ground bone, 600 pounds and muriate of potash, 200 pounds, per acre. The manure is always applied in the fall, ashes and the bone and potash in early spring.

The past season was exceptionally favorable for the production of a heavy yield of hay, but a relative deficiency in rainfall during the period occupied by the growth of the rowen crop was doubtless the principal reason for the falling off in the yield of rowen, as compared with that produced in the season of 1903. The yields of hay and rowen and the total yields for each system of manuring were at the following rates per acre: —

FERTILIZERS USED.	Hay (Pounds).	Rowen (Pounds).	Totals (Pounds).
Barnyard manure,	7,068	2,147	9,215
Bone and potash,	6,024	2,030	8,054
Wood ashes,	4,866	2,064	6,930

The average total yield of the entire area for this year is 8,050 pounds. The average for the entire period during which the experiment has continued (1893 to 1903 inclusive) is 6,597 pounds. The average to date is 6,718 pounds. The average yield when top-dressed with manure has been 7,026 pounds; when top-dressed with wood ashes, 6,304 pounds; when top-dressed with bone and potash, 6,686 pounds. The yields for the past year, it will be noticed, are considerably above the averages for the entire period.

Different Seed Mixtures compared.

In my last annual report[1] will be found a description of the variation in the seed mixtures used on different portions of two plots in this field (1 and 2). In one of these seed mixtures timothy is the most prominent species; in the other, meadow and tall Fescue are prominent; and these different mixtures may be spoken of respectively as the timothy mixture and the Fescue mixture. The timothy mixture is substantially the same as that in general use among farmers, including timothy, red-top, common red clover and alsike clover. The other mixture includes small quantities of all of these species, and in addition Kentucky blue-grass and the two Fescues named. In my last report the statement is made that it is believed that the Fescues will hold the ground more tenaciously than the timothy. The yields last year were materially greater on the portions of the plots occupied by the timothy mixture. The rates of yield on the two mixtures for the past season are as follows: —

	YIELD PER ACRE (POUNDS).	
	Hay.	Rowen.
Plot 1, Timothy mixture,	6,229	2,101
Plot 1, Fescue mixture,	5,769	2,121
Plot 2, Timothy mixture,	5,541	2,129
Plot 2, Fescue mixture,	5,896	2,597

The differences this year are materially less than last, and on Plot 2 the Fescue mixture has given the larger yield.

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[1] Sixteenth annual report, Hatch Experiment Station, pp. 145, 146.

The timothy has not yet been displaced by other species to any noticeable extent, but the poorer showing of the mixture in which it is prominent this year as compared with last possibly indicates that the belief that the Fescue mixture would ultimately prove the better of the two will be justified by the results obtained.

IX. — EXPERIMENT IN THE APPLICATION OF MANURE.

This experiment is designed to ascertain whether it is economically good policy to spread manure during the late fall and winter, and allow it to remain on the surface until spring before plowing under. This system in our experiment is compared with the plan of hauling manure to the field during the winter, and putting it into large heaps. To insure even quality of the manure used in the two systems, it is our practice to manure two plots at one time, putting the loads of manure as hauled to the field alternately upon the two, in the one case spreading, but in the other putting a sufficient number of loads to provide for the entire plot into one large heap. We are using in this experiment five large plots, each of which is subdivided into two subplots. For one of these subplots the manure is spread when hauled out, for the other it is put into a large heap. The area of these subplots is about one quarter of an acre, and to each the amount of manure applied is 11,096 pounds. The manure from well-fed milch cows is used upon eight subplots, and horse manure on two. The manure used in this experiment is applied at different dates during the winter, our practice being to allow the manure to accumulate in the pits from which it is taken until there is a sufficient quantity for at least two subplots. The condition of the soil at the time of application and the nature of the weather which follows must necessarily differ in the different experiments; and these differences, together with the difference in the dates of application above referred to, no doubt in a measure account for the variation in the results of the two systems noticed on the different plots.

The crop in this field last year was soy beans. After the beans were harvested, winter rye was sown as a cover crop.

The date of sowing was necessarily late, and the rye went into the winter very small. There was no injury, however, from winter-killing, and at the date of plowing last spring, May 14, this crop had made considerable growth. The crop of the past season was a mixed growth of Sibley's Pride of the North corn and Medium Green soy beans for ensilage. The corn, on account of seasonal peculiarities several times alluded to in this report, germinated somewhat imperfectly, and there was some damage due to pulling of the young plants by crows. The proportion of corn to beans, therefore, was somewhat lower than is desirable. The date of planting was June 13 and 14, the work having been impossible earlier, on account of the wet condition of the soil. Taking into consideration the condition of the soil at the time of planting and the relatively low temperature of the summer, the crop was fairly satisfactory; but it was undoubtedly unfavorably affected in places because of faulty soil conditions. It was judged that these conditions most seriously affected the several pairs of plots directly compared in the following table as follows: in Plot 1, on the south half; in Plot 2, on the north half; in Plot 3, on the south half; in Plot 4, on the south half; and in Plot 5, on the south half. These facts should be kept in mind in interpreting the results. The rates of yield per acre and the relative standing of the several plots are shown in the following table: —

Actual and Relative Yields of Green Forage. — Corn and Soy Beans.

PLOTS.	ACTUAL YIELDS (RATES PER ACRE, POUNDS).		RELATIVE YIELDS (PER CENT.).	
	North Half, Winter Application.	South Half, Spring Application.	North Half, Winter Application.	South Half, Spring Application.
Plot 1, ...	26,622	24,549	100	92.2
Plot 2, ...	20,548	22,062	100	107.4
Plot 3, ...	15,375	20,007	100	130.1
Plot 4, ...	22,167	20,595	100	92.9
Plot 5, ...	22,959	22,325	100	97.2

Attention is called to the fact that the differences this year, with one exception, are not very large, and that with the single exception alluded to it is the half-plot on which the soil conditions were least favorable which gives the smaller yield. The winter of 1903 and 1904 must be regarded as having been on the whole favorable to winter application. The ground, it is true, was deeply frozen before the coming of snow, but the winter was severely and continuously cold. There was a noticeable absence of winter rains and thaws, during which water washes in large quantities over the surface. In estimating the significance of the result, it must be kept in mind that it costs more to put manure first into a large heap and then in spring to take it from this heap and spread it, than it does to spread during the winter at the time the manure is hauled from the stable. The money difference in the cost of handling manure in the two ways, as shown by our experience, amounts to about $4.80 per acre. The difference in the value of the crops in favor of spring application is scarcely sufficient to cover this added cost, even on Plot 3, where such difference was greatest; and, although the unfavorable soil conditions above referred to doubtless lowered the product on that special plot where the manure was applied in the spring in three instances, plots 1, 4 and 5, it seems highly improbable that, even with equality of conditions, the gain from spring application on these plots would have given a degree of superiority sufficient to cover the added cost.

Previous reports have tended to show spring application to be advisable on this field, which has a considerable slope; and so I still believe it will in the long run prove to be. The exceptional character of the winter of 1903 and 1904 is a sufficient explanation of the difference in average results.

X. — Nitrate of Soda for Rowen.

This experiment is an effort to determine whether an application of nitrate of soda after the harvesting of the first crop will give an increase in rowen sufficient to cover the cost. The field where the experiment has been a number of times repeated is a mixed timothy and clover sod. It is divided into eight plots of like area, these plots being numbered 1 to 8 and each including about three-eighths of an acre. Nitrate of soda at the rate of 150 pounds per acre is applied to plots 2 and 4, while the application on Plot 6 is 200 pounds, and on Plot 8 250 pounds. To the remaining plots no nitrate is applied. The first crop of hay in this field was housed on July 14. The rate of yield was 6,314 pounds per acre.. When this experiment has been tried in previous years, it has been found a matter of considerable difficulty to spread the relatively small amounts of nitrate of soda used evenly; and, as a means of obviating this difficulty, the nitrate used on each plot during the past season was mixed with basic slag meal. The amount of slag meal applied was 137½ pounds per plot, and the slag meal was applied to the plots receiving no nitrate as well as to the others, and on all in equal amounts. The mixture of slag and nitrate remained dry, and its even application was relatively easy. At the rates used, the nitrate and slag were mixed in proportions varying from about one nitrate to three slag to about one nitrate to two slag. Even with the higher proportions of nitrate to slag, the mixture remained dry and in convenient form for application. The rates of yields on the several plots are shown in the following table: —

Nitrate of Soda for Rowen. — Yields per Acre (Pounds).

[Basic slag meal at the rate of 137½ pounds per plot.]

Plots.	NITRATE USED (RATES PER ACRE).	Yield.
Plot 1, . . .	No nitrate, ...	716
Plot 2, . . .	Nitrate of soda, 150 pounds, ...	1,341
Plot 3, . . .	No nitrate, ...	990
Plot 4, . . .	Nitrate of soda, 150 pounds, ...	1,432
Plot 5, . . .	No nitrate, ...	853
Plot 6, . . .	Nitrate of soda, 200 pounds, ...	1,234
Plot 7, . . .	No nitrate, ...	1,021
Plot 8, . . .	Nitrate of soda, 250 pounds, ...	1,862

In the effort to determine whether the application of nitrate is profitable, the yield wherever it has been applied has been compared either with the yield of the nearest plot, or, in cases where it is possible, with the average yield of the two plots between which the plot under consideration lies to which no nitrate was applied. On this basis, the average increase due to application of 150 pounds of nitrate of soda was 499 pounds; the use of 200 pounds of nitrate of soda gave an apparent increase of 297 pounds; while the application of 250 pounds of nitrate of soda gave an apparent increase of 911 pounds. The weather during the period of growth of the rowen crop was too dry for the best results. At the rates of increase shown, the application would be hardly profitable.

XI. — Variety Test, Potatoes.

During the past season we have carried out the second year's trial of forty-nine different varieties of potatoes, including practically all of those of recent origin advertised in prominent seed catalogues up to the spring of 1903, as well as two or three old standard sorts for comparison. The seed used this year was grown from the original stock of each of the varieties on our own grounds in the season of 1903. The seed of all varieties was carefully preserved during the winter under precisely similar conditions. In preparation for planting, the tubers were treated with formalin for prevention of scab, in the customary manner. After removal from the formalin solution, they were spread in a thin layer in an airy room April 30, where they were allowed to lie until the 17th of May, when the tubers were cut into pieces of about two or three eyes each, and planted. The soil used in this experiment is a medium loam. It produced a corn crop in the season of 1903, and mixed grass and clover seeds were sown in the standing corn. Neither grass nor clover had made much growth when the field was plowed on May 3 in preparation for the potatoes. The field received an application of barnyard manure at the rate of 4½ cords per acre, and fertilizers at the following rates: —

	Pounds.
Nitrate of soda,	175
Dried blood,	225
Acid phosphate,	625
Dry ground fish,	400
High-grade sulfate of potash,	350

Both manure and fertilizers were spread evenly after plowing, and harrowed in. The varieties grown and the rate of yield of each are shown in the following table: —

Variety Test Potatoes. — Rates of Yield per Acre.

VARIETY.	Merchantable (Bushels).	Small (Bushels).
Admiral Foote,	208	25
Beauty of Hebron (home grown),	204	35
Beauty of Hebron (Maine seed),	167	21
Clinton,	104	10
Crine's Lightning,	210	7
Daughter of Early Rose,	221	8
Daybreak,	167	29
Early May,	161	33
Early Nancy,	225	27
Early Norwood,	215	40
Early Rose,	256	29
Ensign Bagley,	192	38
Eureka Extra Early,	196	38
Extra Early Pioneer,	204	42
Extra Early White Rose,	294	6
Gem of Aroostook,	248	42
Governor Yates,	259	29
Great Divide,	273	31
Hamilton's Early,	225	8
I. X. L.,	256	38
John Bull,	217	8
Junior Pride,	171	38
Kaiser Krone,	154	50
King of Michigan,	197	60
King of Ohio,	125	29
Market Prize,	256	8
Maxima,	263	31
Million Dollar,	225	13
Mills' New Rose Beauty,	263	15
Milwaukee,	165	25
New Early Wisconsin,	183	33
New Surprise,	204	29
1904,	263	27
Nome,	204	13
Nott's Peachblow,	192	14

Variety Test Potatoes. — Rates of Yield per Acre — Concluded.

VARIETY.	Merchantable (Bushels).	Small (Bushels).
Pat's Choice,	217	11
Peck's Early,	223	10
Prince Henry,	206	17
Red River Triumph,	208	14
Red River White Ohio,	156	31
Sensation,	248	14
Simmon's Model,	319	25
Snowflake, Jr.,	252	8
Steuben,	268	33
Sweet Home,	140	48
Van Ornam's Earliest,	197	17
Vornehm,	185	33
White Ohio,	146	27

The growth of practically all varieties was normal and healthy. The vines were sprayed twice with Bordeaux mixture for prevention of blight and rot. The treatment was successful, and the yield of most varieties was good. One variety, Simmon's Model, gave a yield exceeding 300 bushels per acre. The smallest yield is that given by the Clinton, — 104 bushels of merchantable tubers per acre. Six varieties, mentioned in the order of their productiveness, gave yields of merchantable tubers at rates between 260 and 300 bushels per acre, viz.: Extra Early White Rose, Great Divide, Steuben, Maxima, 1904, Mills' New Rose Beauty. The Beauty of Hebron, which in previous variety tests has given yields almost as large as any under trial, takes a lower rank as the result of the test of last season.

XII. — POULTRY EXPERIMENTS.

The poultry experiments of the past season have followed along precisely similar lines to those followed last year. We are making an effort to throw light on the question as to the proper selection of feeds for laying fowls.

1. In the experiment comparing wheat with corn, animal meal being the source of the animal food used, the following

results were obtained: for the first period, February 3 to May 17, the wheat ration produced eggs at the average rate of .4333 per hen day; the corn ration at the rate of .3837 per hen day; in other words, 100 hens would have laid per day on the wheat ration 43⅓ eggs, and on the corn ration practically 38⅓ eggs per day. For the second period, May 17 to September 30, the wheat ration produced an average of .1911 eggs per hen day, the corn ration .2067 eggs per hen day; or, in other words, 100 hens would have laid on the wheat ration about 19⅒ eggs and on the corn ration 20⅔ eggs per day. The average food cost per egg produced was for the wheat ration .611 cents, for the corn ration .505 cents for the first period; while for the second period the cost per egg on the wheat ration was 1.657 cents, and on the corn ration 1.315 cents. The gross cost of the food on the wheat ration varied from about .24 to .30 cents per day for each fowl, while on the corn ration the cost varied from about .17½ to about .26 cents per day. The yield of eggs during the second period was very small. The small average product is to be attributed largely to the fact that the period was continued beyond the date when the hens began to molt. The 20 hens on the wheat ration laid only 82 eggs during the last two months of the experiment, while those on the corn ration laid only 158 eggs during the same time.

2. In the experiment comparing wheat with corn, with milk albumin as the source of animal food and with corn oil added as a source of fat, the egg product was as follows: for the first period, February 3 to May 17, the wheat ration produced eggs at the average rate of .463 eggs per hen day, the corn ration .4324 eggs per hen day; or, in other words, 100 hens would have laid on the wheat ration practically 46⅓ eggs per day, and on the corn ration 43¼ eggs per day. For the second period the wheat ration gave an average of .3109 eggs per hen day, the corn ration .3017 eggs per hen day; or, in other words, respectively for the wheat ration an average of 31 eggs per 100 hens daily, and for the corn an average of 30⅙ eggs. The food cost of the eggs in this experiment was as follows: for the wheat ration during the

first period .5471 cents per egg, for the second period 1.3406 cents; for the corn ration the figures were for the first period .3932 cents per egg, and for the second .918 cents. The cost of feeding the hens was: for the wheat ration during the first period at the rate of .227 cents per day, for the second period, .39 cents; for the corn ration the cost of food for the first period was .155 cents per hen daily, for the second period .263 cents. The egg yield in this as in the other experiment is very low for the second period. The causes are similar to those which have been pointed out under 1.

3. In the experiment comparing wheat with rice, and with milk albumin as the source of animal food, the results have been as follows: for the first period the egg production was: for the wheat ration .3813 per hen day, for the rice ration .4077; or, in other words, from 100 hens daily respectively about 38⅛ and 40¾ eggs per day. For the second period the averages were on the wheat ration .2244 eggs per hen day, and on the rice ration .3018 eggs per hen day; or from 100 hens daily respectively nearly 22½ and a little more than 30⅙ eggs per day. The food cost of the eggs has been as follows: for the wheat ration for the first period .6976 cents, for the second period 1.59 cents; for the rice ration for the first period 1.1863 cents, for the second period 2.379 cents. The cost of keeping the hens has been as follows: for the wheat ration during the first period .2414 cents per hen daily, for the second period .34 cents; for the rice ration for the first period .4442 cents per hen daily, and for the second period .7003 cents.

The ration including rice this year as last has given one of the most satisfactory egg products obtained. The high cost of this food at the present time seems to preclude its becoming a question of much practical importance whether rice is well or ill suited as a food for egg production. We have introduced it in our experiments as a means of testing the question as to whether fat is an important constituent in the food for laying hens, rice being lower in fat than any other grain we can obtain. The large egg product where rice is prominent among the foods used seems to indicate that fat is less important than has been judged as the result of some of our earlier experiments. Among the various grains, cleaned rice, as put upon our markets, contains least fiber, and rice is known to be the most digestible of all the grains. It is perhaps these pecularities of this grain which account for its apparent good effect on the egg product.

The nutritive ratios in the food combinations used in the different experiments of the past year have been as follows:—

For the rations where wheat is compared with corn with animal meal as the source of animal food: for the wheat ration, 1 : 4.46; for the corn ration, 1 : 6.42.

For the experiment in which wheat is compared with corn, milk albumin being the source of animal food: for the wheat ration, 1 : 4.43; for the corn ration, 1 : 6.18.

In the experiment in which wheat and rice have been compared: for the wheat ration, 1 : 4.35; for the rice ration, 1 : 6.2.

Our experiments throw relatively little light upon the question as to the proper nutritive ratio in feeding for eggs. The factors affecting the egg yield must be numerous, and others than the question of the nutritive ratio in the foods given to the fowls must often determine the results. The fact that we have the most satisfactory egg yield obtained during the past year on the rice ration, with a nutritive ratio of 1 : 6.20, does not at least seem to support the opinion that the nutritive ratio in feeding for eggs should be narrow.

REPORT OF THE HORTICULTURISTS.

F. A. WAUGH; GEO. O. GREENE, ASSISTANT.

The work of this division has followed the plans outlined in the reports of 1902 and 1903. The following subjects are ready for discussion, and reports are made herewith: —

I. Report on plums.
II. Experiments in pruning peach trees.
III. Growing chrysanthemums for a retail trade.

REPORT ON PLUMS.

The horticultural department has a fairly large collection of plums. A number of these are represented by several trees each, enough to determine their commercial quality. The plum crop of 1904 was unusually good; it was abundant in quantity, and generally of good quality. This was true of all classes of plums, practically every variety on the grounds bearing a normal crop. This furnished an excellent opportunity for making observations on the different varieties. The notes follow below. It has been thought best to omit any extended description of these varieties for the present. This form of report is justified by the fact that nearly all the varieties mentioned are old and well-known sorts. The notes this year are valuable chiefly in showing the behavior of these well-known varieties in this particular locality. The problem of local adaption of varieties is nowadays considered to be one of the most important in horticulture, and in no class of fruits or vegetables are these local adaptations more complicated than with plums. The varieties below are classified as nearly as possible into the more commonly accepted pomological groups.

DOMESTICAS.

Agen (*Prune d'Agen*). — Tree unhealthy and a poor grower, moderately productive, an irregular cropper; fruit very good, but not so bright nor large as in some localities.

Bradshaw. — This is one of the best plums of its class, and, indeed, one of the best market and home-use plums of any class on our grounds. We have about twenty young trees in bearing which gave a good crop in 1904. The tree is a strong somewhat upright grower, does not come early into bearing, but bears well after reaching an age of eight to ten years. The fruit buds do not seem to be tender here, as they are in some localities. The fruit is large, smooth, bright and of excellent quality.

Bryanstone. — Tree an irregular and slow grower, late and irregular in bearing; not reliable. Fruit small to medium in size; of good quality.

Clyman. — Represented only by a single specimen, which bears sparsely and does not seem to be of any value.

Dame Aubert (*Yellow Egg*, *Magnum Bonum*). — Tree rather upright in growth, fairly strong and hardy, but does not bear heavily. Fruit large and fine, but very subject to rot.

Damsons. — Several varieties of Damsons are included in our collection, among which the French Damson seems to be the best; this bears fairly well, but by no means as abundantly as in some sections.

Diamond. — A fairly strong, healthy tree, coming late into bearing, and yielding uncertain crops here.

Englebert (*Prince Englebert*). — Tree upright, strong and hardy; does not come early into bearing, but yields good crops after reaching ten years of age. Fruit of medium size and fair quality.

Fellenburg (*Italian Prune*). — Tree round-topped, bushy, with spreading irregular branches; does not bear until eight or ten years of age, and then not very heavily. Fruit of good quality. This variety does not rank so highly as a market plum as in western New York or Michigan.

Field. — Tree seems to be not very strong and healthy, but bears fairly well. Fruit of excellent quality. This is a promising, medium early plum.

Giant Prune. — Our trees are young and poor, and have borne only a few samples. The fruit is large and attractive. This variety is worthy of further test.

Gueii. — Tree rather a bushy grower; fairly productive. Fruit small, sour; not of the best quality.

Hand. — Tree a large, strong grower; shapely; notably unproductive. Fruit large, fine, showy. This variety is certainly not worth planting, the objection being its unproductive character.

Lincoln. — Tree not very strong or sound, and fruit not of very good quality. Not to be recommended, on the basis of our experience.

McLaughlin. — Tree unhealthy and a poor grower; not bearing very heavily. Fruit not so smooth and highly colored as in some sections, but still of very fine quality. In spite of its imperfections of tree, this variety is worth growing on account of its high quality; it would not be profitable in a market orchard.

Moore's Arctic. — Tree vigorous, upright, strong, hardy; productive, and coming fairly early into bearing. Fruit small; rather poor quality.

Peter's Yellow Gage. — Tree not very vigorous or hardy; a slow grower. Fruit small, and not very good for this variety.

Pond. — Tree large, strong grower; fairly productive. Fruit large and excellent, but very much subject to rot, and unprofitable on that account.

Quackenbos. — A very good, medium-sized tree, fairly productive. Fruit medium size; clean and fair quality for one of the small blue plums. This is probably the best of the so-called blue plums, with possibly the exception of Englebert.

Reine Claude. — Tree an irregular grower; not very vigorous, and only moderately productive. Fruit medium size and quality for this variety; considerably subject to rot. This takes the place of the old-fashioned Green Gage, being a larger, better and later variety. It is a very fine plum for canning, but could not be profitably grown for the market in this locality.

Saratoga. — Our single tree of this variety is small, and not very productive; unpromising.

Smith's Orleans. — Tree moderate size, somewhat irregular in growth; moderately productive. Fruit not so large or fine as it should be in this variety.

Tragedy. —We have only one tree of this variety, just coming into bearing; promising.

Victoria. — Tree moderately large; irregular in growth; moderately productive. Fruit of medium size and excellent quality; somewhat subject to rot.

Washington. — In almost all respects like Hand, which see.

JAPANESE VARIETIES.

Abundance. — Tree upright, early bearing; very much subject to disease. This is probably one of the poorest trees to be found amongst the Japanese plums. Fruit of good size and good quality; somewhat subject to rot; very apt to be eaten by birds. We would entirely discard this variety as a commercial plum, on the basis of our experience, and could not recommend it highly for planting for home use. This experience we are aware is different from that of some other plum growers in New England.

Burbank. — Tree vigorous, spreading, hardy; comes early into bearing, and is very productive. Fruit medium to large, good quality; less subject to rot than most plums. This is the most profitable and productive market plum on our grounds.

Chabot. — Tree upright, vase form; hardy, prolific. Fruit medium size, round red; fair quality. This is an excellent market plum, medium to late in season.

Georgeson. — Tree spreading, rather large growing, vigorous and hardy; fairly prolific. Fruit large, yellow; good quality. This is an excellent canning plum, and worth growing in this section, although it does not sell well in the markets on account of its yellow color.

Hale. — Tree upright, very vigorous grower; somewhat subject to winter-killing; coming rather late into bearing, never bearing abundantly. Fruit medium size, round; excellent quality. According to our experience, this variety is not worth planting in this section.

October Purple. — Tree vigorous, upright, and very strong grower; somewhat subject to winter-killing; coming late into bearing, but giving moderate crops after reaching an age of seven or eight years. Fruit medium size, rather dull color; good quality. The variety does not seem to be of any special value in this section.

Paragon. — Somewhat like Chabot, but of no special value.

Red June. — Tree spreading, vase form; vigorous and relatively hardy. The fruit buds on this variety are less hardy than on Burbank, however, sometimes being killed while Burbank survives. Trees bear early and abundantly. The fruit is one of the first to come into the market, and, though of second quality, usually brings a fair price. This is proved to be a profitable plum with us.

Satsuma. — Tree upright, spreading, moderate grower; not very hardy, bearing rather sparsely. Fruit usually small with us; of indifferent quality. Although this variety succeeds in other localities in the Connecticut valley, it is of no value here.

HYBRID VARIETIES.

Apple. — Tree very vigorous, sprawling grower; hardy, coming fairly early into bearing. Fruit medium large, round; dark red with red flesh. On our grounds this variety promises to take the place of Satsuma, to which it seems to be superior in most respects.

Compass Cherry. — An interesting hybrid curiosity, but of no value.

Doris (doubtfully placed among hybrids). — Tree spreading, vigorous, hardy. Fruit small, watery; of no value.

Duke. — Tree medium strong, upright; fruited this year for the first time; of doubtful promise.

Gold (of Stark Brothers). — Tree small, spreading, irregular in growth; hardy, bearing early, but never abundantly on our grounds. Fruit round oblate, medium size, yellow, watery; poor quality, ripening very unevenly; much subject to rot. This variety is of no value with us, and our trees have been mostly grafted to other sorts.

Juicy. — Tree strong and hardy. Fruit small, yellow; of no value.

Wickson. — Tree upright, strong grower; rather tardy in coming into bearing, and never bearing heavy crops; fruit buds tender, apt to be frozen. Fruit of medium size, variable in quality; ripening very irregularly. This variety is not to be recommended here.

NATIVE VARIETIES.

There are on the grounds several native varieties, mostly Americanas, Hortulanas and Chickasaws. Some of these do fairly well, but none of them have conspicuous merit as grown in this section.

Marketing Plums.

The very excellent crop of 1904 gave us an opportunity to study the manner in which plums can be sent to market. For the most part the crop from the department of horticulture of the Massachusetts Agricultural College was marketed in three-pound baskets, such as are used for grapes;

when these were shipped by freight or express, they were packed in crates holding approximately one bushel. This style of package proved generally satisfactory; it furnishes about the quantity of fruit desired by most purchasers.

In making local sales, especially of plums for canning purposes, a larger package was usually more satisfactory. The so-called Jersey peach basket, holding sixteen quarts (one-half bushel), is the cheapest and most convenient.

In some cases, where fancy plums are designed for the fruit stand trade, they may be put up in quart baskets, such as are used for strawberries. We find these also satisfactory.

This whole matter may be summarized by saying that most markets are not fastidious with respect to the form of package used for plums. Any small, neat basket or box will answer, if the fruit is of good quality and well packed.

EXPERIMENTS IN PRUNING PEACH TREES.

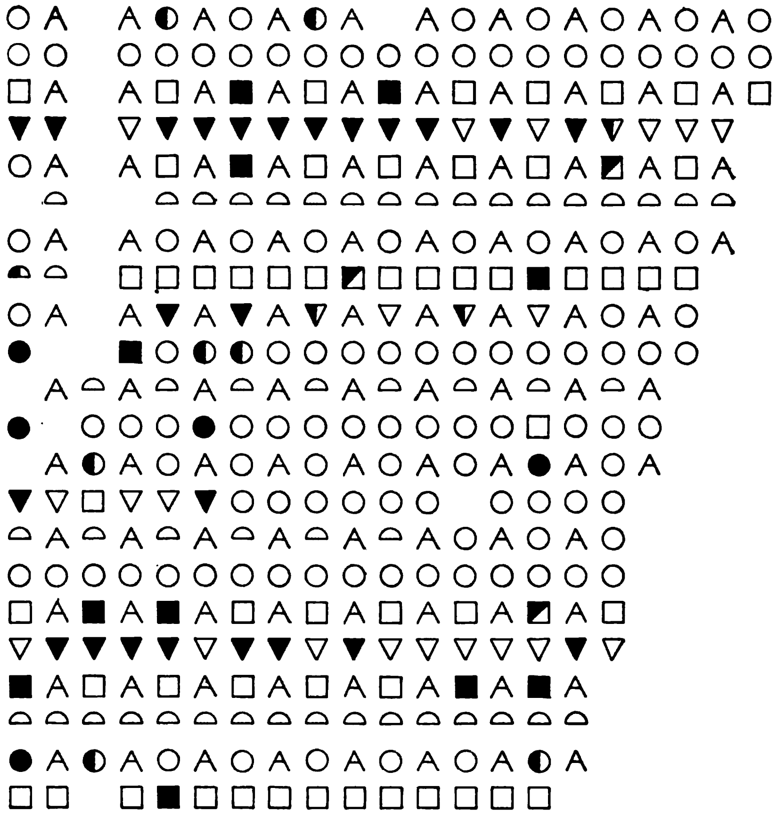
The department of horticulture has under way a series of experiments and special studies in pruning fruit trees. Reports on various phases of this work will be made from time to time as results are reached. At the present time we are able to make a report of progress in the experiments in pruning peach trees.

1. *The Results of No Pruning.*

One row of trees in the principal peach orchard has been left entirely without pruning from the first. This row runs crosswise of the variety rows, and therefore contains trees of all the varieties in the orchard, as follows: Oldmixon, Triumph, Mountain Rose, Elberta, Early Crawford, Late Crawford, Crosby. The trees are nine years old.

These trees, left unpruned for nine years, are plainly different from adjacent trees of the same varieties which have been pruned. Surprising as it may appear on first statement, they are more open-headed. They have generally assumed a vase form. The interior wood has died out, leaving the centres open, and at the same time leaving the lower part of the main branches bare. The fruiting wood is sparse, weak and high up in the trees. The trees are very much less thrifty and vigorous than the pruned trees of the same varieties. This lack of vigor is so marked that some of the weak trees succumbed more or less completely to the severe freezing of last winter.

The trees next the unpruned specimens have been headed back two or three times. They were all headed back moderately in the spring of 1902 and again in the spring of 1903, and some of them were headed back again in the spring of 1904. The trees so treated are thick-topped, with a good deal of weak, sappy growth on the inside, — a condition which is manifestly objectionable. On the other hand, the



MAP OF EXPERIMENTAL ORCHARD. — A shows apple trees 40 feet apart; the circles show peach trees unpruned; the half-circles show those slightly headed back; the squares indicate trees severely headed in; the triangles show trees cut back to stubs; the blackened figures represent trees which died in 1904.

annual growth has been much more vigorous, and the health of the trees has been much better. More and stronger fruit buds have been formed, but unfortunately the successive freezes of the last two winters have killed the buds, and made a comparison of fruit crops impossible. The main branches of the headed-back trees are shorter and stronger than those of the unpruned trees, and are obviously better able to support a large crop of fruit.

This experiment, which was begun by Prof. S. T. Maynard, and which has been continued through several years, has shown conclusively that the best form of peach tree cannot be secured and maintained without pruning.

2. *The Effect of Heading Back.*

Each spring, in the years 1902, 1903 and 1904, a number of trees in the college peach orchards were headed back. This shortening-in of the branches varied in amount: sometimes only one-third of the previous year's growth was cut away, sometimes one-half the year's growth was taken off, sometimes two-thirds was removed; in a few cases the trees were pruned clear back into two or three year old wood; in the majority of cases the heading-in amounted to about two-thirds of the previous year's growth. The cutting back in 1903 and in 1904 was more severe than it would have been had not the prospective fruit crop been wiped out by freezing.

In nearly all cases it was possible to compare trees thus headed in with other trees of the same varieties not so treated. The results were uniform and unequivocal. The trees headed back always made a more healthy and vigorous annual growth than the trees not so treated. In many cases the difference was remarkable, the growth of the pruned trees being from two to ten times as much as the unpruned trees. More and larger fruit buds formed on the pruned trees, and the shorter, stockier branches seemed better prepared to support a possible fruit crop. The foliage on the pruned trees was notably larger, more abundant and darker green. There was some tendency to the formation of weak shoots on the shaded interior branches.

The conclusion which we have reached from this experiment, continued through three years, is that the heading back of peach trees in early spring is good practice, and in all cases advisable. In this pruning from one-third to two-thirds of the wood of the previous year should be removed. In determining the exact amount to be cut away, the judgment of the fruit grower will be influenced largely by the number of living fruit buds in the one-year-old wood. If there is a crop in prospect, he will leave enough fruit buds to set the desired quantity of fruit. In years when, from one cause or another, there are no living fruit buds, he will take advantage of the circumstances to cut back with comparative severity. Only in extraordinary instances, however, will he remove all the previous year's wood, cutting back into two or three year old branches.

3. *Summer Pruning.*

It has been noted above that trees which were headed back in the early spring pruning showed a tendency toward the formation of many weak and useless shoots on the interior of the head. Experiments in summer pruning were begun with a view to the correction of this tendency, and also with a view to stopping the really inordinate extension of the main annual shoots of the current year. The two problems, however, were met in different ways.

The formation of weak sprouts on the interior of the tree is due chiefly to the exclusion of light. The external foliage of the tree top becomes so dense that the interior is shut off from the light and from much of the air. To improve the situation in this respect we have gone through the orchard once or twice between the middle of June and the middle of July, removing a considerable quantity of the new leafy shoots on the outside of the tree. A quantity of the outside shoots and foliage was thus removed sufficient to admit a reasonable amount of light to the inside of the tree top. The work was done with a pair of hand pruning shears, or, when the branches were soft, they were simply torn out with the bare hands. The latter method is preferable, because more expeditious.

In no case were the results of this treatment convincing. The formation of strong shoots with fruit buds on the interior branches was never visibly promoted. The outside branches which were allowed to remain seemed to profit somewhat by the removal of their crowding neighbors, and this was apparently the chief benefit derived from the work. On the whole, it does not seem to us that this practice is to be greatly recommended.

To correct the over-growth of outside branches, the plan was tried of cutting back the young growth. The tips were pinched or the shoots were pruned with hand pruning shears. Sometimes a foot or so of new growth was removed. The pruning was done at various seasons, usually some time in July.

In all cases this treatment was unsatisfactory. The stopping of the growing shoots is often — almost as a rule — followed by the pushing of side buds, and the shoots thus formed are nearly always too weak to set fruit buds, yet in putting out they ruin what might otherwise become strong, sound fruit buds.

4. *Pruning to renew Frozen Trees.*

As the spring of 1903 drew on, it was plain that more or less injury had been suffered by the trees in our peach orchards. In the spring of 1904 the damage was still more obvious and widespread. In both years some experiments were made to learn the best manner of handling a winter-injured tree.

The damage in the spring of 1903 proved to be small, and measures designed to have a corrective effect therefore showed meager results. All the trees came off about equally well, no matter how treated. Some were lightly headed in, some were severely headed in, while a few were cut back nearly to the main trunk, leaving only the stubs of the main branches. In every case not otherwise to be accounted for the tree recovered and made excellent growth.

In the spring of 1904 the trees were seriously weakened by freezing, and some were killed outright, so as to be beyond the reach of any remedial treatment. It should be said, however, that the damage proved to be less sweeping than was feared at the time the year's experiments were outlined. It was decided to lay off the orchard where this experiment was to be made into four blocks, to be given different kinds of treatment, as follows: (1) the first block was to be left entirely without pruning; (2) the second block was to be pruned in midsummer, after the trees had started; (3) the third block was to be cut back, from two-thirds to three-fourths of the previous year's growth being removed; (4) the fourth block was to be headed back near to the trunks, only the stubs of the main branches being left.

A certain percentage of these trees died during the year of 1904. The general result can be seen in the following table: —

Statistical Summary.

	Total Number pruned.	Living, Autumn of 1904.	Dead, Autumn of 1904.	Per Cent. Living.
Trees unpruned, ...	121	113	8	93
Moderately cut back, ...	48	47½	½	99
Severely cut back, ...	68	55	13	81
"Dehorned,"	46	24	22	52

It will be seen that the trees cut back to the trunks ("dehorned") suffered the worst; those severely cut back lost a larger percentage than those unpruned. A careful examination of the orchard itself makes it seem that the difference between blocks 2 and 3 in this respect is considerably exaggerated by the statistics. Some of the deaths in block 3 were apparently due to other causes, and should not be charged up against the pruning. Moreover, the growth made by the headed-in trees which lived was decidedly better than that made by the unpruned trees. The judgment of all those who saw the orchard and examined it carefully during the latter part of the summer of 1904 was that the trees moderately cut back showed the best growth and were in the best condition.

It at least seems clear that the trees seriously weakened by freezing should not be cut back close to the main trunks.

GROWING CHRYSANTHEMUMS FOR A RETAIL TRADE.

BY FRANCIS CANNING.

The work in the college greenhouses has to a certain extent been carried along on the lines and in many respects similar to that of a country florist's establishment, having a local trade. The many problems which present themselves under such conditions have been the subject of considerable experiment.

A florist's establishment in a country town is managed on a very different basis from that which obtains in growing cut flowers for the wholesale market, where two or three varieties of flowers are grown in quantity.

To meet the demands of a local trade requires the handling of a large variety of cut flowers and plants, not necessarily large in quantity, yet sufficient to meet the demand when any particular variety is in season.

One of the principal crops a florist grows under such conditions is the chrysanthemum, and it necessarily follows that he must be familiar with the earliest and latest flowering varieties, so as to prolong the season as far as possible. He must also ascertain which varieties are the best adapted for pot plants, also the colors which suit his trade.

The chrysanthemum having a short season, it follows that considerable forethought is necessary in the arrangement of space devoted to it; it frequently means the crowding of some other crops until that occupied by the chrysanthemum becomes available. To the uninitiated the transformation at the close of the chrysanthemum season, from beds filled with blooming plants to those occupied with other material, seems remarkable; yet the florist has long prearranged this matter in his mind. At this stage the saving of the necessary stock plants is done. In this connection a weeding out of undesirable varieties, or varieties that do not reach the standard in the grower's judgment, is accomplished. Various methods of saving the stock plants are practised; but we have found the use of boxes five or six inches in depth, with provision for drainage, to be a good method. It is better, however, not to mix several varieties in one box, for even though placed separately, the creeping stems will invade each other's territory, and result in mixing the varieties when the cuttings are taken. The boxes should be afforded a reasonably good place in a cool greenhouse, where the sun may reach them, so they do not have a soft, spindly growth, a condition exceedingly detrimental to future success.

Propagating commences in February, or much earlier when any special variety is to be considerably increased. After two batches of cuttings have been rooted, the boxes containing the stock plants may be thrown away, depending upon the newly propagated plants for future cuttings. From the earlier-rooted cuttings the varieties suitable for pot plants are selected, and are potted on as their needs demand. For the general stock for benching, or, in other words, for the cut flowers, the best time to propagate is from April 15 to May 1; thus suitable provision is made to have strong plants in two and one-half or three inch pots by the time the season arrives for planting. No specific date in this connection is observed, some florists commencing to plant in May and others late in July; but when the propagating has taken place at the previously mentioned date, the plants will be in good condition from the 15th to the end of June.

The question as to the advantages of solid beds or benches is of some interest. Our experience has been in favor of solid beds. We are, however, favored with a soil of a porous character, and gravelly subsoil, which for solid beds insures a good drainage, — a necessity for this crop. Wherever one may secure similar conditions, it would seem advisable to adopt this method, and thus avoid the expense of building benches and keeping them in repair.

The young plants are planted in rows eight inches apart each way, allowing two or three shoots to form, and thus secure the same number of blooms from each plant.

The soil used for benches and pot plants is a good, turfy loam, and is composted the previous fall or in the early spring of the same year. To three parts of soil is added one part of well-rotted manure, with bone meal to the amount of one quart to the barrowful of compost. To avoid fungous diseases, keeping the plants in good health by careful culture is the best preventative. For disposing of the ever-present aphis, or black fly, fumigation with tobacco has proved the surest and cheapest remedy. Throughout the year chrysanthemums should be subjected to a weekly fumigation, the prevention of insects being especially desirable in their successful management.

About forty varieties of chrysanthemums are grown in the college greenhouses, many of them represented by a few plants only, to ascertain their merits for such a trade as ours. This method of becoming acquainted with newer varieties should be adopted by all progressive florists. The fact remains, however, that many older varieties have not yet been superseded. Not infrequently the size of bloom has been the principal point in favor of the newer introductions, sacrificing in some instances their purity of color.

The following varieties have proved themselves well adapted for a local trade, being easily grown and naturally vigorous. In their order of flowering they are: white, — Polly Rose, Ivory, Alice Byron, Queen, Timothy Eaton, W. H. Chadwick, Merry Christmas; pink, — Glory of the Pacific, Pink Ivory, George Carpenter, Mrs. Perrin, Mrs. C. F. Berwind, Mrs. S. T. Murdock, Maud Dean; yellow, — Sinclair, Robert Halliday, Colonel Appleton, Major Bonaffon, W. H. Lincoln, W. H. Reiman; bronze, — Brutus, Sunrise, Petaluma; red, — Gettysburg, Malcome Lamond, Cullingfordii. The varieties that do well as pot plants are: Ivory, Alice Byron, Pink Ivory, Mrs. Perrin, Mrs. S. T. Murdock, Mrs. C. F. Berwind, Sinclair, Major Bonaffon, W. H. Lincoln, Brutus, Sunrise, Cullingfordii.

The singles and pompons should not be overlooked. They may be grown in pots with very little disbudding. They have a wide range of colors, and make salable pot plants; the white ones afford good material for designs, etc. Among the best may be mentioned Snowdrop, President, Julia Lagravere, Queen of England, Mizpah, Buttercup.

A great aid in the matter of testing the qualifications of varieties is the use of the "scale for judging" adopted by the Chrysanthemum Society of America. In scaling a variety a searching investigation is made, and many defects are apparent not ordinarily observed. In the work of the class in floriculture in the Massachusetts Agricultural College special emphasis has been placed upon judging chrysanthemums. Some practice will soon develop a rapid and correct estimate of the merits of varieties, and should prove valuable to the average florist.

The commercial scale is as follows: —

Color,	20
Form,	15
Fullness,	10
Stem,	15
Foliage,	15
Substance,	15
Size,	10
Total,	100

The score upon a number of varieties follows: —

	Major Bonaffon.	*The Queen.*
Color,	18	15
Form,	12	10
Fullness,	10	6
Stem,	15	15
Foliage,	15	10
Substance,	12	8
Size,	10	10
Total,	92	74

	Black Hawk.	*Colonel Appleton.*
Color,	20	20
Form,	7	12
Fullness,	10	8
Stem,	7	13
Foliage,	12	10
Substance,	8	12
Size,	8	10
Total,	72	85

These scores may vary from those awarded the same varieties by the Chrysanthemum Society of America. Our conditions may be accountable for the variation.

Some varieties present features especially desirable for a retail trade, — good keeping qualities, oddities in shape or color, etc. Those presenting desirable features, from two or three years' tests, follow: —

Baer, Mrs. G. F. — Known as Yellow Jerome Jones, and presents many of the fine characteristics of this fine variety.

Berwind, Mrs. C. F. — Dark pink, with silvery reverse; good keeper; a desirable kind.

Black Hawk. — Dark crimson; one of the handsomest of this color, and should be grown where there is any demand for this color.

Brutus. — Orange red; very dwarf in character; makes good pot plant and cut flowers; a desirable color, and satisfactory.

Byron, Miss Alice. — One of the best whites; makes a fine pot plant, and good for cut flowers.

Carpenter, George. — Medium early, dark pink flower; there is a demand for this variety when well grown.

Childs, G. H. — One of the best dark reds for cut flowers.

Dean, Maud. — One of the best pinks; large flower, good shape; fine for Thanksgiving trade.

Golden Trophy. — A desirable kind for pot plants.

Idavan. — Fine solid pink flower, shading to cream; a few are desirable.

Intensity. — Red; a good pot plant.

Jones, Mrs. Jerome. — One of the best whites.

Liberty. — A good late yellow; grown cool, will last till Christmas.

Merry Christmas. — A correspondingly late white variety.

Millbrook. — An odd salmon pink; a few pot plants may be serviceable.

Murdock, Mrs. S. T. — A desirable kind for cut flowers and plants; shell pink in color.

Mutual Friend. — A good white variety.

Petaluma. — An odd quilled-petalled variety; bronze or brown in color; good keeper.

Philadelphia. — Lemon yellow; globular flower; good for fancy trade.

Pitcher, Miss Georgiana. — A good old robust yellow variety, easily grown.

Reiman, W. H. — Yellow globular; late, good for Thanksgiving and later.

Rose, Polly. — An indispensable early variety.

Sunderbruch, H. L. — An early yellow; fine large flowers; good for pots.

Many other prominent varieties are being tested, a second year being desirable, to determine their value.

PUBLIC DOCUMENT . . . . No. 60.

FOURTEENTH ANNUAL REPORT

OF THE

DAIRY BUREAU

OF THE

MASSACHUSETTS BOARD OF AGRICULTURE,

REQUIRED UNDER

CHAPTER 89, SECTION 12, REVISED LAWS.

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DAIRY BUREAU—1904.

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HENRY E. PAIGE, AMHERST.

Secretary.

J. LEWIS ELLSWORTH, *Executive Officer and Secretary of the State Board of Agriculture.*

General Agent.

P. M. HARWOOD.

ADDRESS, ROOM 136, STATE HOUSE, BOSTON.

Commonwealth of Massachusetts.

REPORT.

Any one looking over the work of the Dairy Bureau for the past few years can but notice the different conditions which it has been called upon to meet, particularly along the line of police duties. In its early history the larger part of the work was in the prosecution of oleomargarine dealers. Later, renovated butter came to the front; this was followed by a curtailment in the oleomargarine trade. Last year violations of the renovated butter law reached a climax, and when it was found that the law was being enforced the dealers became more law-abiding, until to-day we have a healthier condition of law observance on the part of both oleomargarine and renovated butter dealers than we have had for some years. Another phase of work has appeared this year, as a result of which we have had 55 cases in court for the adulteration of cream with formaldehyde.

During the four years next preceding the one covered by this report there were many violations of law discovered, and these seemed to increase in number, though varying in kind, until last year the maximum of cases in court (289) was reached. The annual number of inspections has also constantly increased until this year, the State being covered more systematically and thoroughly than ever before; we have found but 168 cases of violation of law to enter in court.

The matter of educational work has been entered into more fully than formerly, with future promise of increased work along that line; and the Bureau has purchased special equipment for the purpose of giving stereopticon lectures and instruction upon questions relating to better production, care, handling and a more rational consumption of dairy products.

There has been but one change in the membership of the Bureau. Mr. A. M. Lyman, whose term as a member of the Board of Agriculture expired in January, became no longer eligible, and was succeeded by Dr. Henry E. Paige. Mr. C. D. Richardson has continued as chairman and Mr. P. M. Harwood as general agent. Mr. A. W. Lombard has been regularly employed as agent, and five others have been temporarily employed, as occasion required. Most of the chemical work has been done by Dr. B. F. Davenport, although three other chemists have been incidentally employed in some of the oleomargarine cases.

The general agent has acted as judge in special dairy tests at two fairs, Sturbridge and Palmer; and, by special appointment by the Governor, was sent as delegate to the Pure Food Congress at St. Louis, September 26 to October 1, inclusive.

The work of the year has been as follows: —

Total number of inspections,	*5,594
Number of inspections where no samples were taken,	4,456
Number of samples of butter and oleomargarine, nearly all purchased,	887
Number of samples of milk and cream,	270
Cases in court,	168
Meetings addressed by the general agent,	28
Meetings addressed by the chairman of the Bureau,	15

Cases prosecuted during the year, by months and courts, with law violated, and results, are as follows: —

COURT.	Month.	Number.	Law violated.	Convicted.	Discharged.
Lowell,	January,	4	Oleomargarine,	4	–
Quincy,	January,	4	Renovated butter,	4	–
Cambridge,	January,	5	Renovated butter,	5	

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* Nineteen extra samples were taken during inspections, therefore this total is nineteen less than the sum of the next three items.

COURT.	Month.	Number.	Law violated.	Convicted.	Discharged.
Malden, . .	January, .	2	Renovated butter, .	2	–
Haverhill, .	January, .	2	Renovated butter, .	2	–
Abington, .	February, .	2	Renovated butter, .	–	2
Waltham, .	February, .	2	Oleomargarine, .	2	–
New Bedford, .	February, .	20	Renovated butter, .	20	–
Newburyport, .	February, .	4	Renovated butter, .	4	–
Attleborough, .	March, .	2	Renovated butter, .	2	–
Brockton, .	March, .	6	Renovated butter, .	6	–
Worcester, .	March, .	4	Renovated butter, .	4	–
Lowell, . .	April, .	2	Renovated butter, .	2	–
Taunton, .	April, .	2	Renovated butter, .	2	–
Gloucester, .	May, . .	2	Renovated butter, .	2	–
Clinton, . .	May, . .	1	Oleomargarine, .	1	–
Lowell, . .	May, . .	1	Oleomargarine, .	1	–
Worcester, .	June, . .	3	Oleomargarine, .	3	–
Waltham, .	June, . .	1	Oleomargarine, .	1	–
Lowell, . .	June, . .	2	Oleomargarine, .	2	–
Boston, . .	June, . .	3	Oleomargarine, .	3	–
Lowell, . .	June, . .	1	Oleomargarine, .	1	–
Boston, . .	June, . .	8	Milk, . . .	8	–
Lawrence, .	August, .	1	Oleomargarine, .	1	–
Chelsea, . .	August, .	2	Renovated butter, .	2	–
Lawrence, .	September, .	9	Milk, . . .	9	–
Worcester, .	September, .	2	Oleomargarine, .	2	–
Cottage City, .	September, .	5	Milk, . . .	5	–
New Bedford, .	October, .	14	Milk, . . .	14	–

Court.	Month.	Number.	Law violated.	Convicted.	Discharged.
Fall River, .	October, .	12	Milk, . . .	12	–
Attleborough, .	October, .	14	Milk, . . .	14	–
New Bedford, .	November, .	4	Milk, . . .	4	–
Plymouth, .	November, .	7	Milk, . . .	7	–
New Bedford, .	December, .	10	Renovated butter, .	10	–
New Bedford, .	December, .	1	Oleomargarine, .	1	–
Worcester, .	December, .	4	Renovated butter, .	4	–
		168		166	2

The charges in the several cases in court for the year have been as follows: —

Selling renovated butter in unmarked packages, ...	73
Oleomargarine in imitation of yellow butter, ...	20
Oleomargarine served in restaurants without notifying guests, .	2
Milk adulterated, ...	55
Milk below standard, ...	18
Total, ...	168

The following is a list of inspections without samples and the number of samples taken in the years 1900–1904 inclusive: —

Year.	Inspections without Samples.	Samples taken.
1900, ...	1,612	826
1901, ...	1,757	911
1902, ...	3,895	1,078
1903, ...	4,135	1,395
1904, ...	4,456	1,157
Totals, ...	15,855	5,367
Averages, ...	3,171	1,073+

The following is a list of the number of cases entered in court and also the number of convictions secured in the years 1900–1904 inclusive: —

YEAR.	Total Cases.	Convictions.
1900,	178	144
1901,	252	218
1902,	285	238
1903,	289	272
1904,	168	166
Totals,	1,162	1,038
Average convictions,	–	208—

OLEOMARGARINE.

The oleomargarine situation is always a matter of public interest. Considered on its merits, oleomargarine is one thing; as a counterfeit of butter, it is quite another. As showing the effect of the United States law of 1902, the following figures are of interest. The total output of oleomargarine in the United States for the year ending June 30, 1902, was 126,316,472 pounds; while that for the year ending June 30, 1904, was 48,071,480 pounds. Of this latter amount, only 1,639,102 pounds paid the ten-cent tax as colored goods. As showing the combined effect of the United States law and the enforcement of the State laws, the whole number of licenses as per last year's report was 352; this year 151, — a falling off of 201; a shrinkage of 76 + per cent in the number of "colored" and of 55— per cent in the number of "uncolored" licenses.

Notwithstanding this decrease, and the fact that oleomargarine can be sold uncolored under certain restrictions in this State, there have been attempts to violate the laws, both State and national. Three Rhode Island factories tried this in the early part of the year. Some of our chemists succeeded in discovering the presence of extraneous coloration, and the Bureau immediately set about prosecuting the dealers for selling oleomargarine in imitation of yellow butter. This was followed by the United States Internal Revenue Department taking action, with the result that two of the factories went out of business, the other apparently mending its ways. Obviously, this is a business that will bear watching at all times.

The number of persons who paid a United States tax the past three years is shown by the following table: —

YEARS ENDING JUNE 30.	Wholesale.	Retail.
1903 (colored),	1	24
1903 (uncolored),	7	314
1904 (colored),	–	17
1904 (uncolored),	9	326
Current year (colored),	–	4
Current year (uncolored),	9	138

RENOVATED BUTTER.

Undoubtedly butter will and should be renovated, as long as an inferior article, whether improperly made or improperly kept, exists. The business has grown, until, according to Secretary Wilson's report, 54,000,000 pounds was the product of the year ending June 30, 1904. Much of this is sold in such form that there can be no mistaking what it is; sometimes, however, it is sold for butter, put up in plain, unmarked wrappers. This latter method the law expressly forbids, and our prosecutions have been where such practices occur; and never, during the last two years, have we put a case in court where there were not two or more violations of the law, tending to show that it was the actual practice of the offender and not an accident.

EDUCATIONAL.

As has already been intimated, the Bureau is doing what it can to educate towards the production of clean milk, to better methods of handling, and to a better care of milk and its products in the hands of the purchaser. We have endeavored to lose no opportunity to enforce this idea upon the public. We believe there is improvement year by year, but recognize that there is room for more.

The producer naturally thinks that, if he could get a better price for his milk product, he could then afford to take more pains with it, which is undoubtedly true; and the consumer owes it to himself, to his family and to the welfare of everybody, not to so much question the price of milk and cream, within certain limits, as to insist upon its quality and condition. No one ought to expect milk containing 5 per cent fat for the same price as that containing 3.7 per cent fat. The producer ought to be able to sell his milk on its merits, just the same as the dry goods merchant does his cloth; and this should apply to freedom from deleterious bacteria, as well as to fat content. It seems as though an adjustment of prices along this line would assure to the consumer clean milk, and give the producer encouragement to produce better goods, and also a fair remuneration for his labor.

At the same time, it should be recognized that there is more than one way to increase income; and that clean milk, clean cream and first-class butter or cheese will increase consumption, and thereby enlarge the market for these most desirable articles of food. Many a business man has succeeded by increasing his production to a paying point without increasing the price.

Habits of cleanliness are not so expensive as they are hard to form; but, when once formed, it is believed that they pay for themselves in one's increased standing, reputation, improved physical health, mental power and moral worth; all of which contribute not only to happiness, but increase earning power as well.

Much of the cream brought into our market to-day comes from without the State. Most of this is pasteurized cream. In a smaller way a still better product is produced under superior sanitary conditions, such, in fact, that the cream keeps readily ten or more days, and with no other treatment than to keep it sufficiently cool and tightly sealed. Some dealers warrant such cream to keep sweet two weeks, if held at or below 50° Fahrenheit. The use of glass or paper bottles, in sizes suited to the wants of the customer, in handling milk or cream, is of great advantage: first, because standard milk thus put up must still analyze to law requirements; second, because of convenience in handling; third, milk or cream put up in such bottles need not be opened until ready for use; and the consumer who wants the best of milk will never unseal a can or bottle until it is wanted, and will not allow unsealed bottles of milk or cream to stand in or out of a refrigerator for any considerable length of time.

It should not be overlooked that we are only a little more than twenty-four hours distant from the great milk-producing centre of our country, where the cost of production is much less than here; and that the day has now arrived when sanitarily produced cream can be shipped long distances, and in such condition that it will keep sweet a week or more after arrival, if properly cared for. Our local cream, however, prepared under like conditions, is good for some hours or days longer, and our cost of transportation less. Massachusetts to-day does not send beyond New England, except for pasteurized cream, some 6,000 to 8,000 gallons of which are brought from Iowa; but she does send thousands of dollars to neighboring States for cream which keeps well, for the reasons above given, and which, much of it, could be profitably produced within our own borders. It seems as if Massachusetts producers could get a large share of this trade, if they pushed for it.

The chairman of the Bureau has delivered fifteen and the general agent twenty-eight lectures, bearing upon dairy topics during the year.

BUTTER.

There has been, according to the best reports available, a large increase in the annual production of butter in this country, — probably ten per cent and possibly more in the last two years. Ten per cent of the product of June 30, 1902, to June 30, 1903, which was estimated at 1,500,000,000 pounds, would amount to 150,000,000 pounds; the falling off of the oleomargarine product of 78,000,000 pounds, which it took an equal amount of butter to replace, would leave a net increase of 72,000,000 pounds of butter for the year 1903–1904 to depress the market. Then, too, the 54,000,000 pounds of renovated butter, elsewhere referred to, comes much nearer competition with creamery butter than would that which was renovated. This accounts to a considerable extent for the ruling low price, and argues that the farmer has not only had a larger market for his butter, but the consumer has not been obliged to pay an extra price for it.

The following table shows the extreme quotation for the best fresh creamery butter in a strictly wholesale way in the Boston market for the last eight years: —

	1904. Cents.	1903. Cents.	1902. Cents.	1901. Cents.	1900. Cents.	1899. Cents.	1898. Cents.	1897. Cents.
January, . .	22.7	28.0	25.0	25.0	29.5	21.0	22.5	22.0
February, . .	24.6	27.0	28.5	25.0	26.0	24.0	21.5	22.0
March, . .	24.1	27.0	29.0	23.0	27.0	22.5	22.0	23.0
April, . . .	21.6	27.5	32.0	22.0	21.0	21.0	22.5	22.0
May, . . .	19.9	22.5	25.0	19.5	20.5	19.0	18.0	18.0
June, . . .	18.4	22.75	23.5	20.0	20.5	19.0	17.5	16.0
July, . . .	18.3	20.5	22.5	20.0	20.5	19.0	18.5	16.5
August, . .	19.1	20.0	21.5	21.0	22.5	21.5	19.5	19.0
September, . .	20.8	22.0	23.5	22.0	22.5	23.5	21.0	22.0
October, . .	21.5	22.5	24.5	21.5	22.0	24.0	21.5	22.5
November, . .	24.1	23.5	27.0	24.0	25.0	26.5	21.0	22.0
December, . .	25.7	24.5	28.5	24.5	25.5	28.0	21.0	23.0
Averages, .	21.73	26.23	25.0	22.3	23.5	22.4	20.5	20.6

The Chamber of Commerce's figures regarding the butter business in Boston for 1903 and 1904 are as follows: —

	1904. Pounds.	1903. Pounds.
On hand January 1,	7,567,360	6,248,920
Receipts for the year,	55,435,207	54,347,056
Total supply,	63,002,564	60,595,976
Exports, deduct,	1,373,815	842,692
Net supply,	61,628,749	59,753,284
Stock on hand December 31, deduct,	5,612,592	7,567,360
Consumption,	56,016,157	52,185,924

MILK.

The wholesale price of milk in Boston the past year has been the same as in 1903, and with but few exceptions the retail price the same. If the condition of milk as it leaves the farm or arrives in the market is on the whole improving year by year, it is largely attributable to the agitation of the clean milk question by those especially interested.

As to violations of the milk laws, this department has been called upon to do more work than usual. In conjunction with Dr. Harrington 8 cases were brought in Boston, and with Milk Inspector Scanlon of Lawrence 9 cases in that city; 55 cases for formaldehyde in cream were brought in Cottage City, New Bedford, Fall River, Attleborough and Plymouth.

The following tables show the wholesale prices of milk sent to the Boston market for the last ten years: —

Summer Price.

	Gross Boston Price. Cents.	"Straight Price," Boston. Cents.	Gross to Producer, Fifth Zone. Cents.	Straight Price to Producer, Fifth Zone.* Cents.
1895, April to October, .	33	-	22	-
1896, " " .	33	-	22	-
1897, " " .	31†	-	22	-
1898, " " .	31	-	22	-
1899, " " .	31	-	22	-
1900, " " .	33	-	24	-
1901, " " .	33	31	24	22
1902, " "	36 in April, July, August, September. 35 in May, June.	34 in April, July, August, September. 33 in May, June.	27 26	25 24
1903, " " .	37½	35½	28½	26½
1904, " " .	37½	35½	28½	26½

Winter Price.

1895-6, October to April,	37	-	26	-
1896-7, " "	35	-	24	-
1897-8, " "	33†	-	24	-
1898-9, " "	33	-	24	-
1899-0, " "	33	-	24	-
1900-1, " "	37 to January. 35 to April.	-	28 to January. 26 to April.	-
1901-2, " "	36 40 in December.	34½ 38½ in December.	27 31	25.5 29.5
1902-3, " "	39½	37½	30½	29
1903-4, " "	39½	37½	30½	28½
1904-5, " "	39½	37½	30½	28½

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* The price in the fifth zone, *i.e.*, the middle territory, is approximately the average price which the producers receive for their milk.

† This is a nominal rather than an actual change. With the dropping of the Boston price 2 cents the distance discount-schedule was also lowered 2 cents, so that producers received the same price.

Creameries and Milk Depots in Massachusetts.

LOCATION.	Name.	Co-operative or Proprietary.	Superintendent or Manager.
Amherst,	Amherst Creamery,	Co-operative,	F. J. Humphrey, agent.
Amherst,	Fort River,	Proprietary,	E. A. King.
Amherst,	Dairy School, Massachusetts Agricultural College.	Educational,	Prof. W. P. Brooks, director.
Ashby,	Ashby Creamery,	Proprietary,	C. Foster.
Ashfield,	Ashfield Creamery,	Co-operative,	Geo. G. Henry.
Belchertown,	Belchertown Creamery,	Co-operative,	M. G. Ward, president.
Boston, 494 Rutherford Avenue,	H. P. Hood & Son,	Proprietary,	H. P. Hood & Son.
Boston, 793 Boylston Street,	Walker-Gordon Laboratory Company.	Proprietary,	Walker-Gordon Laboratory Company.
Boston, 356 Rutherford Avenue,	D. Whiting & Sons,	Proprietary,	D. Whiting & Sons.
Boston, 388 Rutherford Avenue,	Boston Dairy Company,	Proprietary,	Boston Dairy Company.
Boston, 105 Holmes Avenue,	Hingham Dairy Association,	Proprietary,	Hingham Dairy Association.
Boylston,	Adelphia Creamery,	Proprietary,	E. M. Laws.
Bridgewater,	Plymouth County Creamery,	Proprietary,	H. A. Wilbor.
Cambridge, 158 Massachusetts Avenue,	C. Brigham Company,	Proprietary,	C. Brigham Company.

Charlemont,	Charlemont Creamery,	Proprietary,	T. M. Totman.
Cheshire (P. O., Adams),	Greylock Creamery,	Co-operative,	C. J. Fales, president.
Cheshire,	Highland Creamery,	Proprietary,	Clayton W. Prince.
Cheshire,	West Shore Creamery,	Proprietary,	Seth W. Curtis.
Chester,	Chester Creamery,	Co-operative,	W. S. Wilcox.
Conway,	Conway Creamery,	Co-operative,	W. A. Pease.
Cummington,	Cummington Creamery,	Co-operative,	S. W. Clark, president.
Easthampton,	Hampton,	Co-operative,	W. H. Wright, treasurer.
Egremont (P. O., North Egremont),	Egremont Creamery,	Co-operative,	H. O. Harrington.
Everett,	Hampden Creamery Company,	Proprietary,	Hampden Creamery Company.
Framingham (P. O., South Framingham).	Framingham Creamery,	Proprietary,	W. E. Marchent.
Fitchburg, 26 Cushing Street,	Fitchburg Creamery,	Proprietary,	G. S. Learned.
Gardner,	Boston Dairy Company,	Proprietary,	Boston Dairy Company.
Groton,	Lawrence Creamery,	Proprietary,	Myron P. Swallow.
Heath,	Heath Creamery,	Proprietary,	I. W. Stetson & Son.
Hinsdale,	Hinsdale Creamery,	Co-operative,	G. T. Plunkett.
Lee,	Lenox Creamery,	Proprietary,	P. A. Agnew.
Leominster,	Leominster Creamery,	Proprietary,	G. S. Wass.
Marlborough,	Este's Creamery,	Proprietary,	F. F. Este.

Creameries and Milk Depots in Massachusetts — Concluded.

LOCATION.	Name.	Co-operative or Proprietary.	Superintendent or Manager.
Monson,	Monson Creamery,	Proprietary,	W. C. Moulton.
Montague,	Montague Creamery,	Co-operative,	A. M. Lyman.
Monterey,	Berkshire Hill Creamery,	Co-operative,	Henry Clapp, treasurer.
New Boston,	Berkshire Creamery,	Co-operative,	F. M. Rugg.
New Salem (P. O., Millington),	New Salem Co-operative Creamery Company.	Co-operative,	W. A. Moore.
North Brookfield,	North Brookfield Creamery,	Proprietary,	H. A. Richardson.
Northfield,	Northfield Creamery,	Co-operative,	L. R. Smith.
Orange (P. O., North Orange),	North Orange Creamery,	Co-operative,	Jonathan Holt.
Oxford,	Cold Spring Creamery,	Co-operative,	C. H. Wellington.
Shelburne Falls,	Shelburne Falls Creamery,	Proprietary,	Rufus Covell.
Southborough,	Deerfoot Farm,	Proprietary,	S. H. Howes.
Southfield,	Maple Lawn,	Proprietary,	A. C. Lockwood.
Springfield,	Springfield Milk Association,	Co-operative,	F. B. Allen.
Springfield,	Tait Bros.,	Proprietary,	Tait Bros.
Uxbridge,	Farnum Creamery,	Proprietary,	Geo. A. Farnum.

Warren,	Worcester County Creamery Association.	Co-operative,	F. N. Lawrence, treasurer.
Westfield (P. O., Wyben),	Wyben Springs Creamery,	Co-operative,	C. H. Wolcott.
West Newbury,	West Newbury Creamery,	Co-operative,	R. S. Brown.
Williamsburg,	Williamsburg Creamery,	Co-operative,	E. T. Barrus, president.
Worthington (P. O., Ringville),	Worthington Creamery,	Co-operative,	M. R. Bates.
Worcester,	Wachusett Creamery,	Proprietary,	E. H. Thayer & Co.